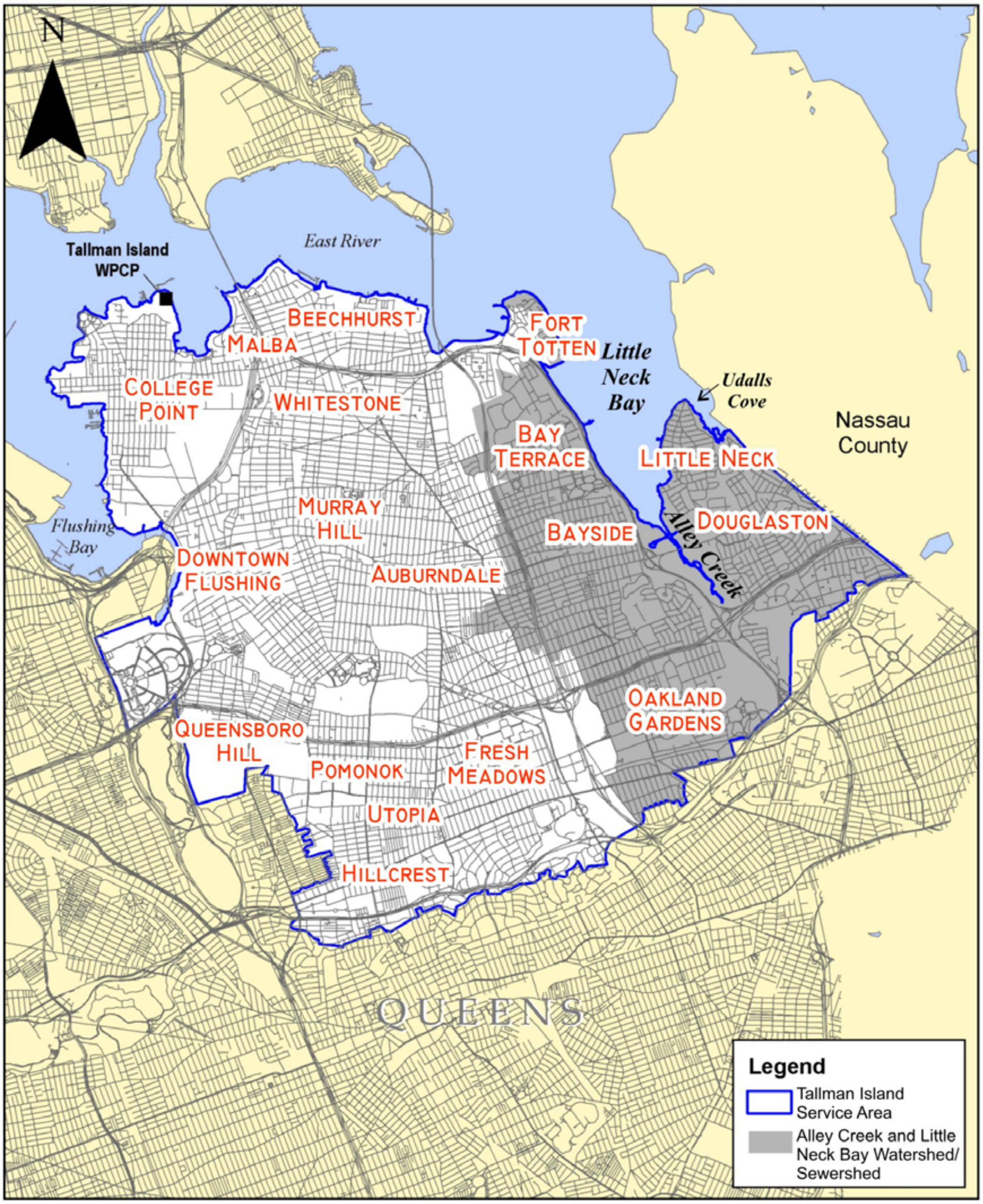
3.0 Existing Sewer System Facilities

The Alley Creek and Little Neck Bay watershed/sewershed is divided between two major political jurisdictions: the Queens Borough of New York City and Nassau County, Long Island, New York. Most of the Queens County portion of watershed is served by the Tallman Island WPCP and associated collection system, shown on Figure 3-1 and described in Section 3.1. The Douglaston neighborhood, on the east bank of Little Neck Bay in Queens Borough, is principally served by on-site septic systems. Wastewater management in the Nassau County portion of the watershed is accomplished by three sanitary sewer districts: 1) the Belgrave Water Pollution Control District, the Great Neck Water Pollution Control District and the Village of Great Neck. The treated effluent from the Belgrave WPCP discharges to Udalls Cove, on the east side of Little Neck Bay. The treatment plants for the other two districts discharge to Manhasset Bay on the east side of the Great Neck Peninsula. In addition, there are properties not in the service areas of these three sewer districts that use on-site septic systems. The locations of the three wastewater treatment facilities and the respective sewershed boundaries are shown in Figure 3-2 and described in Section 3.3.

3.1 TALLMAN ISLAND WPCP

The Tallman Island WPCP is permitted by the NYSDEC under SPDES permit number NY-0026239. The facility is located at 127-01 134th Street, College Point, NY, 11356 in the College Point section of Queens, on a 31-acre site adjacent to Powells Cove, leading into the Upper East River, and bounded by Powells Cove Boulevard. The Tallman Island WPCP serves a sewered area of approximately 12,925 acres in the northeast section of Queens, including the communities of Little Neck, Douglaston, Oakland Gardens, Bayside, Auburndale, Bay Terrace, Murray Hill, Fresh Meadows, Hillcrest, Utopia, Pomonok, Downtown Flushing, Malba, Beechhurst, Whitestone, College Point, and Queensboro Hill. The total sewer length, including sanitary, combined, and interceptor sewers, that feeds into the Tallman Island WPCP is 430 miles. The Tallman Island WPCP has been providing full secondary treatment since 1978. Processes include primary screening, raw sewage pumping, grit removal and primary settling, air-activated sludge capable of operating in the step aeration mode, final settling, and chlorine disinfection. The Tallman Island WPCP has a design dry weather flow (DDWF) capacity of 80 million gallons per day (MGD), and is designed to receive a maximum flow of 160 MGD (2 times DDWF) with 120 MGD (1.5 times DDWF) receiving secondary treatment. Flows over 120 MGD receive primary treatment and disinfection. Wet weather flows to the Tallman Island WPCP are limited to less than 2 times DDWF due to conveyance system limitations which are currently being addressed by NYCDEP. The Tallman Island WPCP 2007 wet weather average sustained flow is 142 MGD. The daily average flow during 2007 was 55.2 MGD, with a dry weather flow average of 53.9 MGD (NYCDEP, 2008). Table 3-1 summarizes the Tallman Island WPCP SPDES permit limits.



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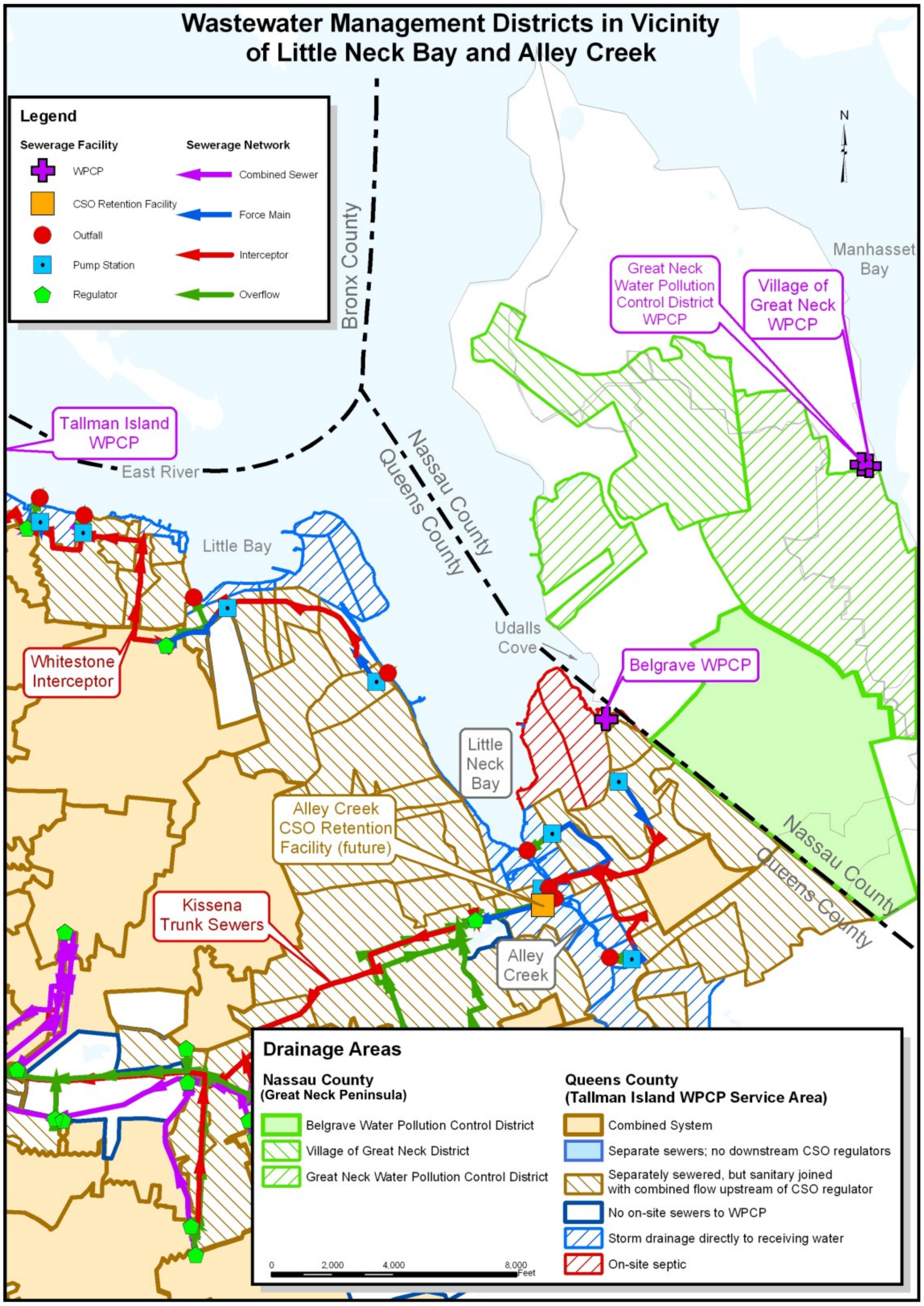
Alley Creek and Little Neck Bay Waterbody/Watershed Facility Plan

Alley Creek and Little Neck Bay Watershed/Sewershed and WPCP Service Areas

FIGURE 3-1



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Wastewater Management Districts in Vicinity of Little Neck Bay and Alley Creek

Alley Creek and Little Neck Bay Waterbody/Watershed Facility Plan

FIGURE 3-2

Table 3-1. Select Tallman Island WPCP Effluent Permit Limits

Parameter	Basis	Value	Units
Flow	DDWF Maximum secondary treatment Maximum primary treatment	80 120(1) 160	MGD
$CBOD_5$	Monthly average 7-day average	25 40	mg/L
TSS	Monthly average 7-day average	30 45	mg/L
Total Nitrogen	12-month rolling average	108,375(2)	lb/day

(1) 1.5 DDWF.
(2) Nitrogen limit for the Combined East River Management zone, calculated as the sum of the discharges from the four Upper East River WPCPs (Bowery Bay, Hunts Point, Wards Island, Tallman Island) and one quarter of the discharges from the 2 Lower East River WPCPs (Newtown Creek, Red Hook). This limit is effective through November 2009, then decreases stepwise until the limit of 44,325 lb/day takes effect in 2017.

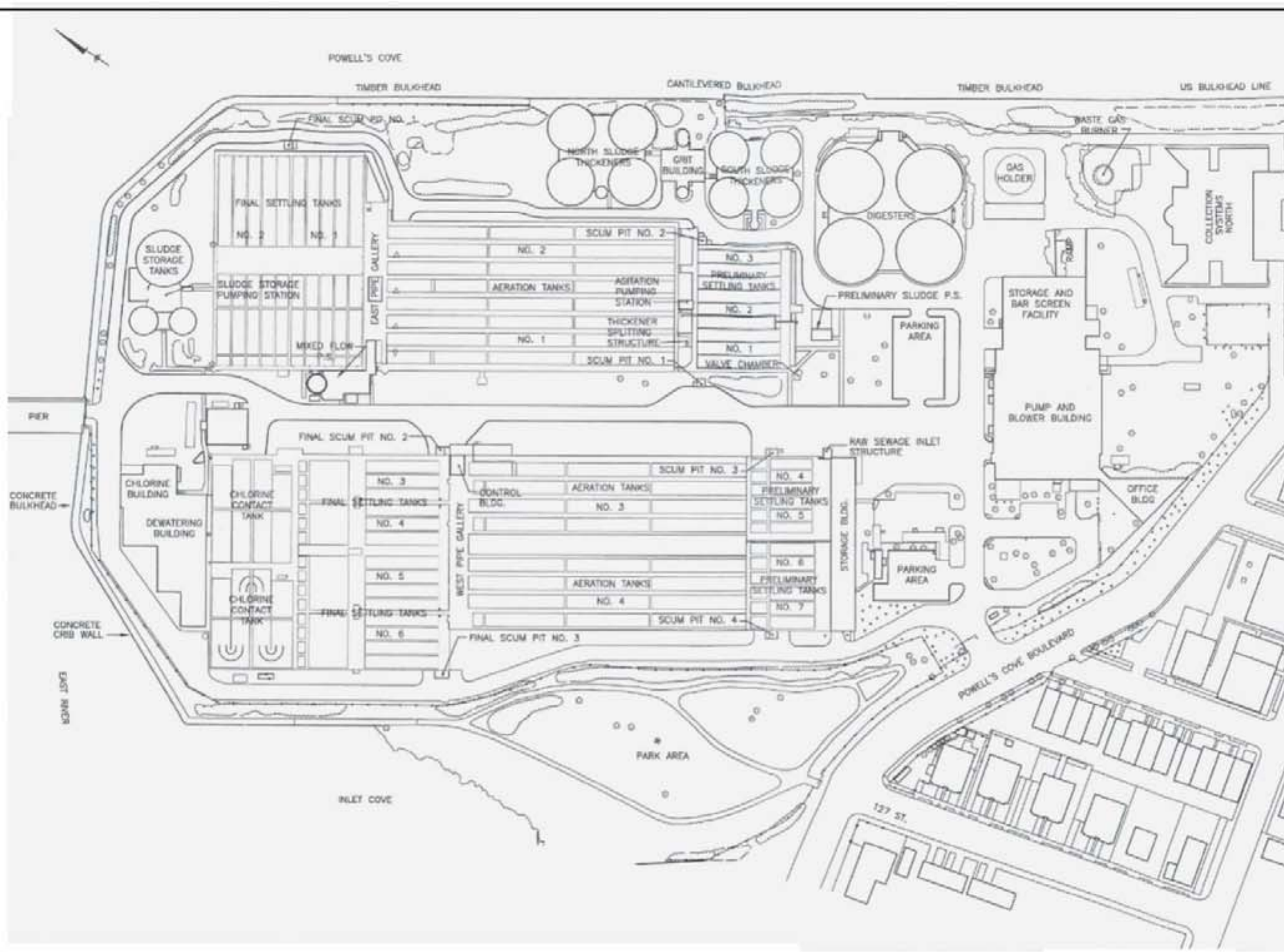
The original Tallman Island plant was designed in the early 1930s. The plant began operation to treat wastewater with a step aeration design capacity of 40 MGD in time for the 1939 World's Fair held at Flushing Meadows Park. The original plant was designed to serve an estimated 300,000 people. Several major expansions and upgrades were completed in 1964 (upgrade and expansion to 60 MGD) and 1979 (upgrade and expansion to 80 MGD). In April 1997, construction was completed for Basic Step Feed Biological Nitrogen Removal (BNR) retrofit at Tallman Island. This included the installation of baffles in each pass of the aeration tanks to create anoxic zones, submersible mixers in each anoxic zone to prevent solids settling, and froth-control chlorine spray hoods for filament suppression.

3.1.1 Tallman Island WPCP Process Information

Figure 3-3a shows the current layout of the Tallman Island WPCP and Figure 3-3b is an aerial view of the facility. The WPCP is located on a peninsula bounded by water. The landside adjacent to the WPCP is a residential neighborhood.

Wastewater from the Flushing Main Interceptor and Whitestone Interceptor discharges to a 7-foot by 7-foot combined sewer interceptor which conveys flow to the forebay of the Tallman Island WPCP. Upon entry to the screenings building, the flow passes through the four screening channels to the influent channel to the wet well. Each screening channel is provided with a hydraulically operated sluice gate used for channel isolation and throttling. There are four climber-type mechanical bar screens that are six feet wide with 1-inch openings. The screens are cleaned with a vertical climber rake and are designed to handle 53.3 MGD.

From the wet well, the main sewage pumps pump the flow into the pump discharge header. There are five vertical, centrifugal, mixed-flow, bottom-suction, flooded-suction, main sewage pumps, two rated at 55 MGD and three rated at 60 MGD. Each pump draws flow from the wet well via a 48-inch suction line and discharges via a 36-inch line that includes a cone check valve and a gate valve. The 36-inch line connects to a header that increases in size to 72-



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Alley Creek and Little Neck Bay Waterbody/Watershed Facility Plan

Tallman Island WPCP Site Layout

FIGURE 3-3a

New York City
Department of Environmental Protection

Tallman Island WPCP Aerial View

Alley Creek and Little Neck Bay Waterbody/Watershed Facility Plan

FIGURE 3-3b

inches. The header splits into two 54-inch force mains, each with a fabricated venturi meter, to convey the flow to primary settling tanks.

The Powells Cove Pump Station is a separate pump station located at the Tallman Island WPCP which receives flow from approximately 375 acres in College Point. This flow is conveyed to the treatment plant via the 36-inch College Point Interceptor sewer. The pump station consists of three vertical centrifuge pumps with a total capacity of 9.3 MGD with two pumps online and a single, manually cleaned bar screen. The Powells Cove Pump Station discharges to the Flushing Main Interceptor which discharges to the headworks of the plant.

Two batteries of primary clarifiers are provided with three settling tanks in the east battery and four settling tanks in the west battery, giving seven primary settling tanks in total. Flow is distributed to the seven primary settling tanks through 24-inch by 24-inch sluice gates. Each settling tank has six sluice gates. Primary effluent flows over weirs at the end of each tank into the primary settling tanks effluent channel. Scum is removed from each tank by a manually operated rotating scum collector and is temporarily stored in four scum concentration pits prior to off-site disposal. Each rectangular clarifier includes three longitudinal chain and flight collectors and a chain flight cross collector to direct sludge to a sludge pit. The sludge is then pumped to the primary sludge degritters. The total volume of the primary settling tanks is 3.5 million gallons (MG) with a surface overflow rate of 2,073 gallons per day per square foot (gpd/sf) at average design flow. The overflow rate at peak design flow is 4,000 gpd/sf.

From the primary settling tanks, primary effluent flows by gravity to the four aeration tanks for biological treatment, Tanks 1 and 2 in the east battery and Tanks 3 and 4 in the west battery. The total aeration tank volume is 14.8 MG and is aerated at 20,100 standard cubic feet per minute (scfm) through ceramic tube diffusers.

Aeration tank effluent is conveyed to the final settling tanks designed for 790 gpd/sf at 80 MGD. The plant has a total of six final settling tanks. The east plant final settling tanks receive flow directly from the aeration tank effluent channel and are comprised of two rectangular tanks with five bays. Each bay has a chain and flight mechanism that directs sludge to a cross-collector channel. Cross-collectors direct the sludge to an airlift pump chamber. Return activated sludge (RAS) is conveyed back to the aeration tanks by four airlift pumps. Waste activated sludge (WAS) is drawn off from the airlift pump chamber to the mixed flow pumping station. Effluent from the east battery final settling tanks is directed to the chlorine contact tanks.

In the west plant, aeration tank effluent is discharged from the 48-inch diameter aeration tank effluent pipe. The west plant has two rectangular final tanks, each with three bays, and two rectangular tanks, each with four bays. Each bay has a chain and flight mechanism that directs sludge to a cross-collector channel. Cross-collectors move the sludge to the airlift pit where RAS is pumped by four airlift pumps. WAS is removed by draw-off lines at waste sludge manholes. From the manholes, the WAS flows by gravity to the mixed flow pumping station. Effluent from the west battery final settling tanks is directed to the chlorine contact tanks.

The disinfection system consists of two 4-pass chlorine contact tanks, two sodium hypochlorite storage tanks, two metering pumps, and an automated control system. Sodium hypochlorite solution is pumped to the influent through diffusers. The two tanks have a total volume of 2.16 MG and a detention time of 19.4 minutes at peak design flow. Chlorinated effluent is discharged to the East River through a submerged outfall.

Primary sludge from both batteries is pumped through cyclone degritters to remove grit. The degritted sludge, along with WAS from the mixed flow pumping station, is discharged to the gravity thickeners. Grit flows to the grit classifiers/washers where the grit is washed and separated from liquid and stored in containers prior to off-site disposal.

Two sets of four circular, conical-bottomed gravity thickeners are used for sludge thickening. The north gravity thickeners are 60-feet in diameter and the south gravity thickeners are 50-feet in diameter. Each thickener contains a picket-type stirring mechanism that aids thickening and directs sludge to the center pit where it is pumped to anaerobic digesters. Each thickener has two plunger pumps directly below that send the sludge into the digester-heating loop.

Sludge is mixed within each digester by three draft tube mixers. To heat the digester contents, sludge is pumped from the digesters through external heat exchangers. Each digester has a dedicated heat exchanger. The main source of heat is the engine jacket cooling water system. Sludge is removed from each digester using four pipes at various depths and locations within the digester. The pipes are manifolded to four sludge transfer pumps. The pumps can either pump sludge to two of three storage tanks or return it to the digester for further digestion. Currently, the sludge is pumped from the storage tanks through two dedicated sludge pumps to two sludge centrifuges in the dewatering building. The dewatered sludge is then removed and trucked out of the plant. The centrate is returned to the head of the plant by gravity.

3.1.2 Tallman Island WPCP Wet Weather Operating Plan

NYCDEP is required by its SPDES permit to maximize the treatment of combined sewage at the Tallman Island WPCP. The permit requires treatment of flows of up to 120 MGD, 1.5 times the DDWF, through complete secondary treatment. Further, to maximize combined sewage treatment, the SPDES permit requires flows of up to 160 MGD (2 times DDWF) to be processed through all elements of the WPCP except the aeration basins and the final settling clarifiers.

New York State requires the development of a Wet Weather Operating Plan (WWOP) as one of the 14 BMPs for collection systems that include combined sewers. The goal of the WWOP is to maximize flow to the WPCP, one of the nine minimum control elements of long-term CSO control planning. NYCDEP has developed a WWOP for each of its 14 WPCPs, and Table 3-2 summarizes the requirements for the Tallman Island WPCP, and notes that flows beyond the maximum capacity of the aeration basins and final clarifiers (i.e., over 160 MGD) would cause damage to the WPCP by creating washout of biological solids and clarifier flooding. The WWOP therefore suggests that the facility is operating at or near its maximum capacity without being forced to shunt excess flow directly from the primary clarifiers to the chlorination basins. The WWOP for Tallman Island was submitted in May 2007, and is attached as Appendix A.

Table 3-2. Wet Weather Operating Plan for Tallman Island WPCP

Unit Operation	General Protocols	Rationale
Influent Gates and Screens	Leave gate in automatic position until wet well capacity is hit, plant flow approaches 160 MGD, or bar screens become overloaded. Maintain acceptable wet well level by throttling back on influent gates. Set additional screens into operation and set screen rakes to continuous operation in order to accommodate increased flow.	To protect the main sewage pumps from damage and allow the plant to pump the maximum flow through preliminary treatment without flooding bar screens, bar channels, screen room, and wet well.
Main Sewage Pumps	As wet well level rises, put off-line pumps in service and increase speed of pumps up to maximum capacity, leaving one pump out of service as standby.	Maximize flow to treatment plant and minimize need for flow storage in collection system and associated overflow from collection system into Long Island Sound.
Primary Settling Tanks	Check levels of primary tank influent channels and effluent weirs for flooding. Switch pumps in service as necessary.	Maximize the amount of flow that receives primary treatment, protect downstream processes from abnormal wear and solids overload/scum accumulation.
Bypass Channel	Visually monitor the bypass channel.	To relieve flow to the aeration system, avoid excessive loss of biological solids, relieve primary clarifier flooding, and prevent secondary system failure due to hydraulic overload.
Aeration Tanks	Keep all aeration tanks in operation using the step feed mode and adjust the airflow to maintain a dissolved oxygen greater than 2 mg/L. Adjust wasting rates if necessary.	To maintain a desired solids inventory in the aerators.
Final Settling Tanks	In case of a longitudinal collection failure, maintain final tanks in service. Balance flows to the tanks to keep blanket levels even.	To prevent solids washout in the clarifiers.
Chlorination	Check, adjust, and raise the hypochlorite feed rates to maintain adequate residual.	Hypochlorite demand will increase as flow rises and secondary bypasses occur.
Sludge Handling	Proceed as normal.	Uninfluenced by wet weather.

3.1.3 Other Operational Constraints

NYSDEC and NYCDEP entered into a Nitrogen Control Consent Order that updated the New York City SPDES permits to reduce nitrogen discharges to the Long Island Sound and Jamaica Bay to reduce the occurrence of eutrophic conditions and improve attainment of dissolved oxygen numerical criteria. The Consent Order was partly a result of the Long Island Sound Study, which recommended a 58.5 percent load reduction of nitrogen discharge. The Consent Order specified process modifications at the four WPCPs that discharge into the Upper East River (Bowery Bay, Hunts Point, Tallman Island, Wards Island) and one of the WPCPs that discharges to Jamaica Bay (26th Ward) for nitrogen removal. “The Modified Phase I BNR Facility Plan for the Upper East River and the 26th Ward Water Pollution Control Plants” was prepared by NYCDEP and submitted to NYSDEC in 2005. It outlines the modifications necessary to upgrade these five WPCPs. The critical BNR upgrade items for Phase I construction are as follows:

1. Aeration tank equipment modifications:
   - Baffles for the creation of anoxic/switch zones and pre-anoxic zones
   - Mixers in the anoxic zones
2. Process aeration system upgrades:
   - New blowers or retrofit of existing blowers
   - New diffusers (fine bubble)
   - Air distribution control equipment
   - Metering and dissolved oxygen (DO) monitoring and control
3. Return activated sludge (RAS) / Waste activated sludge (WAS) systems:
   - Expanded capacity or upgrade of existing RAS/WAS system, as applicable
4. Froth control system:
   - Implemented to prevent or control filamentous growth
5. Chemical addition facilities:
   - Sodium hypochlorite for froth control (RAS and surface chlorination)
   - Alkalinity addition for nitrification and pH buffering (except at Tallman Island)

NYCDEP has pledged to perform interim measures during the Phase I construction period to make best efforts to reduce the levels of nitrogen being discharged into the East River. These measures include:

1. Wards Island Battery E additional upgrades:
   - Enhanced flow control in the aeration tanks
   - Supplemental carbon addition facilities
   - Additional baffles to enhance flow distribution and settling in final settling tanks
2. The SHARON Process will be constructed at Wards Island including:
   - Reactor tanks with both aerated and anoxic zones;
   - Influent centrate pumping station and controls;
   - Blowers and process air piping, distribution grid and diffusers;
   - Mixers for the denitrification zone;
   - Alkalinity storage and pumping station;
   - Supplemental carbon storage and pumping station;
   - Recycle pumps;
   - Temperature control units; and
   - Electrical power substation.
3. Relocation of Bowery Bay and Tallman Island digested sludge and/or centrate via shipping with NYCDEP marine vessels or contract services. The NYCDEP can send this material to either a NYC facility or an out-of-city facility.

Concurrent with the BNR upgrades, the NYCDEP continues to perform extensive upgrade work as part of the Plant Upgrade (PU) Program at all WPCPs, including the five that are undergoing BNR retrofits. Plant upgrades are required to stabilize or replace equipment that has reached its intended design life to ensure reliable plant performance that is in compliance with the existing SPDES permits for each WPCP.

Upgrade of Tallman Island WPCP

The Tallman Island WPCP is scheduled to undergo a construction upgrade program to address the facility's critical needs and upgrade the aeration process to basic step-feed BNR process. This work is currently in progress and has a Consent Order completion date of December 31, 2010.

This section summarizes the major improvements to be implemented as part of the first phase of the Tallman Island WPCP Upgrade Program.

- <u>Main Sewage Pumping Station</u> – The existing main sewage pumps, suction, discharge piping and valves will be demolished and replaced with five new centrifugal-type pumps each capable of pumping 60 MGD. The facility will have the capability of pumping at least 160 MGD to the preliminary settling tanks during wet weather with three pumps in operation. During this work, a temporary pump around system will be installed in the influent channels following the primary screens. The temporary pumping system will be capable of pumping a maximum flow of 120 MGD. As a result, during and temporary pumping period, the Tallman Island WPCP will only be able to process a maximum wet weather flow of 120 MGD or 1.5 times the DDWF. The existing conveyor system for the Main Influent Screens will be demolished and replaced in-kind. This work should have no effect on the plant's ability to accept and treat wet weather flow.

  The Powells Cove Pumping Station, located in the plant Pump and Blower Building, will also be upgraded. The existing pumps and climber screen will be demolished and replaced with three new pumps each capable of 4 MGD and a new climber screen. Temporary pumping units capable of handling the entire Powells Cove Pumping Station flow will be provided during this phase of the work. As a result, this work will not impact the Plant ability to accept and/or treat wet weather flow.

- <u>Primary Tanks</u> – The Primary Tanks at the Tallman Island WPCP will be provided with new flights and chains as part of this construction contract. During this work, only one primary tank at a time will be taken out-of-service. As a result, the Tallman Island Primary Tanks should be able to process a maximum wet weather flow of 160 MGD without a reduction in permit performance during this phase of construction.

- <u>Aeration Tanks</u> – The aeration tanks at the Tallman Island WPCP will be modified to provide basic step-feed BNR. Baffles will be added to allow for separation of anoxic and aerobic treatment zones. Mixers will be provided in the anoxic zones to maintain the suspension of biomass. A new aeration system including fine bubble diffusers will be provided along with new centrifugal process air blowers. The existing air header will be rehabilitated to reduce air losses and a new dissolved oxygen (DO) control system will be provided. The existing spray water system will be demolished and replaced with a new system capable of providing full tank coverage. New influent gates will be added to the aeration tanks to allow for uniform flow distribution to each pass. Automation will be provided to allow storm flow to be sent to Pass D of each aeration tank so as to prevent biomass washout. Two froth control hoods will be added in both Pass A and B of each aeration tank to limit the generation of filamentous froth. Surface wasting will also be provided to maintain the solids residence time (SRT) and prevent nocardia and foam accumulation. Centrate from the dewatering building will be conveyed to Pass A of the aeration tanks by gravity. As with the primary tank work, only one aeration tank will be taken out of service by the contractor at any time. As a result, the system should be capable of processing a wet-weather flow of 120 MGD for short durations without a significant effect on overall treatment performance.

- <u>RAS and WAS System</u> – New submersible RAS pumps will be added to the system with the capacity of 64 percent of design dry weather flow. RAS chlorination will be provided to prevent sludge bulking. WAS will be conveyed from Pass A and B of the aeration tanks. Additional instrumentation will be provided to measure RAS flow and RAS total suspended solids (TSS) concentrations.

- <u>Gravity Thickeners</u> – The existing eight gravity thickeners will undergo complete rehabilitation. New mechanisms, drive units, over-flow piping and sludge pumps will be provided under this phase of the upgrade. Since six gravity thickeners are required by the plant at any time, the Contractors will be allowed to upgrade two gravity thickeners at a time, without affecting the plant's ability to process wet weather flows.

- <u>Mixed Flow Pumping Station</u> – The existing pumps in the mixed flow pump station will be demolished and replaced. Due to the current space limitations, the pumps will be replaced in-kind with new pumps of the same capacity. As part of this upgrade, the spray water system will also be replaced. The capacity of the spray water system will be increased, but only to the extent possible within the existing footprint of the mixed flow pumping station. Only one mixed flow pump will be taken out of service at any time. As a result, this work will not affect the plant's ability to treat wet weather flows.

- <u>Sludge Digestion and Storage</u> – The existing covers on the four digesters will be demolished and replaced. New gas piping will be provided from the digester tank covers to the gas compressor building. Gas compressors are required to mix the digester gas produced during anaerobic decomposition of the sludge with natural gas and boost the pressure for utilization in the engine drive units currently proposed to drive the main sewage pumps and process air blowers. New piping will be provided from the digester sludge transfer pumps to the existing sludge storage tanks located near the dewatering building.

- <u>Miscellaneous Upgrade Improvements</u> – Miscellaneous improvements included in this phase of the plant upgrade will include the rehabilitation of the existing boiler plant, the replacement of the existing grit cyclones and classifiers in kind and the addition of temporary personnel facilities including lockers, showers and administration area.

Concurrent with the BNR upgrades, the NYCDEP will continue to perform extensive upgrade work as part of the Plant Upgrade Program at the Upper East River WPCPs and the 26th Ward WPCP. Plant upgrades are required to stabilize or replace equipment that has reached its intended design life to ensure reliable plant performance that is in compliance with the existing SPDES permits for each WPCP.

3.2 TALLMAN ISLAND WPCP COLLECTION SYSTEM

The Tallman Island sewershed is comprised of both sanitary and combined sewersheds, as shown in Figure 3-4, and summarized below in Table 3-3.

Table 3-3. Tallman Island WPCP Drainage Area: Acreage Per Sewer Category

Sewer Area Description	Area (acres)
Combined	**8,032**
Separate Fully separated Watershed separately sewered, but with sanitary sewage subsequently flowing into a combined interceptor and stormwater subsequently either discharging directly to receiving water or into combined interceptor	**4,893** (610 acres) (4,283 acres)
Other	**2,171**
Total WPCP Service Area	**15,096**
Note: An additional 1,483 acres of areas that do not contribute stormwater to the WPCP were modeled as well, including areas with direct drainage of stormwater to water courses via storm sewers, other areas not served by piped drainage systems (e.g., parks and cemeteries) and the “on-site” septic areas in Douglas Manor on Douglaston Peninsula.	

The Tallman Island WPCP collection system includes 430 miles of combined and sanitary sewers and interceptors varying in size from 10-inch diameter street laterals to 13-foot by 6-foot trunk and interceptor sewers. There are four principal interceptors in the collection system: the Main Interceptor, the College Point Interceptor, the Flushing Interceptor, and the Whitestone Interceptor.

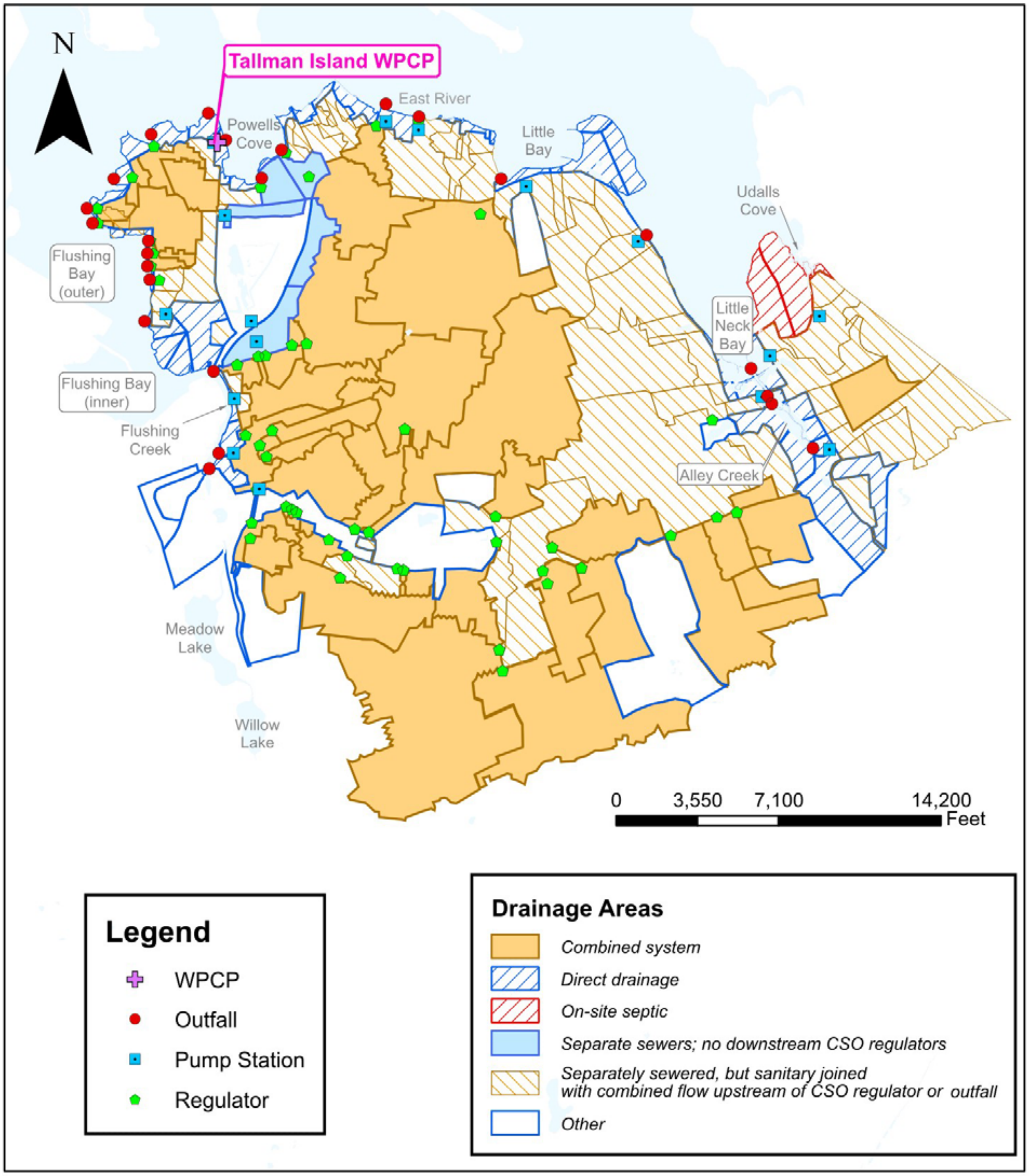
- The Main Interceptor is directly tributary to the Tallman Island WPCP and picks up flow from the other three interceptors.

- The College Point Interceptor, which carries flow from sewersheds to the west of the treatment plant, discharges into the Powells Cove Pump Station, which discharges into the Main Interceptor.

- The Whitestone Interceptor discharges to the Main Interceptor shortly upstream of College Point input, via gravity discharge. The Whitestone conveys flow from the area east of the treatment plant along the East River.

- The Flushing Interceptor can be considered an extension of the Main Interceptor south of the Whitestone connection and serves most of the areas to the south in the system. The Flushing Interceptor also picks up flow from the southeast areas of the system, along the Kissena Corridor (via trunk sewers upstream of the TI-R31 regulator) and from the Douglaston area east of Alley Creek.

These principal sewers are mapped in Figure 3-5. The Tallman Island WPCP sewer system schematics with and without the Alley Creek Tank and Flushing Tank are included as Appendix E.



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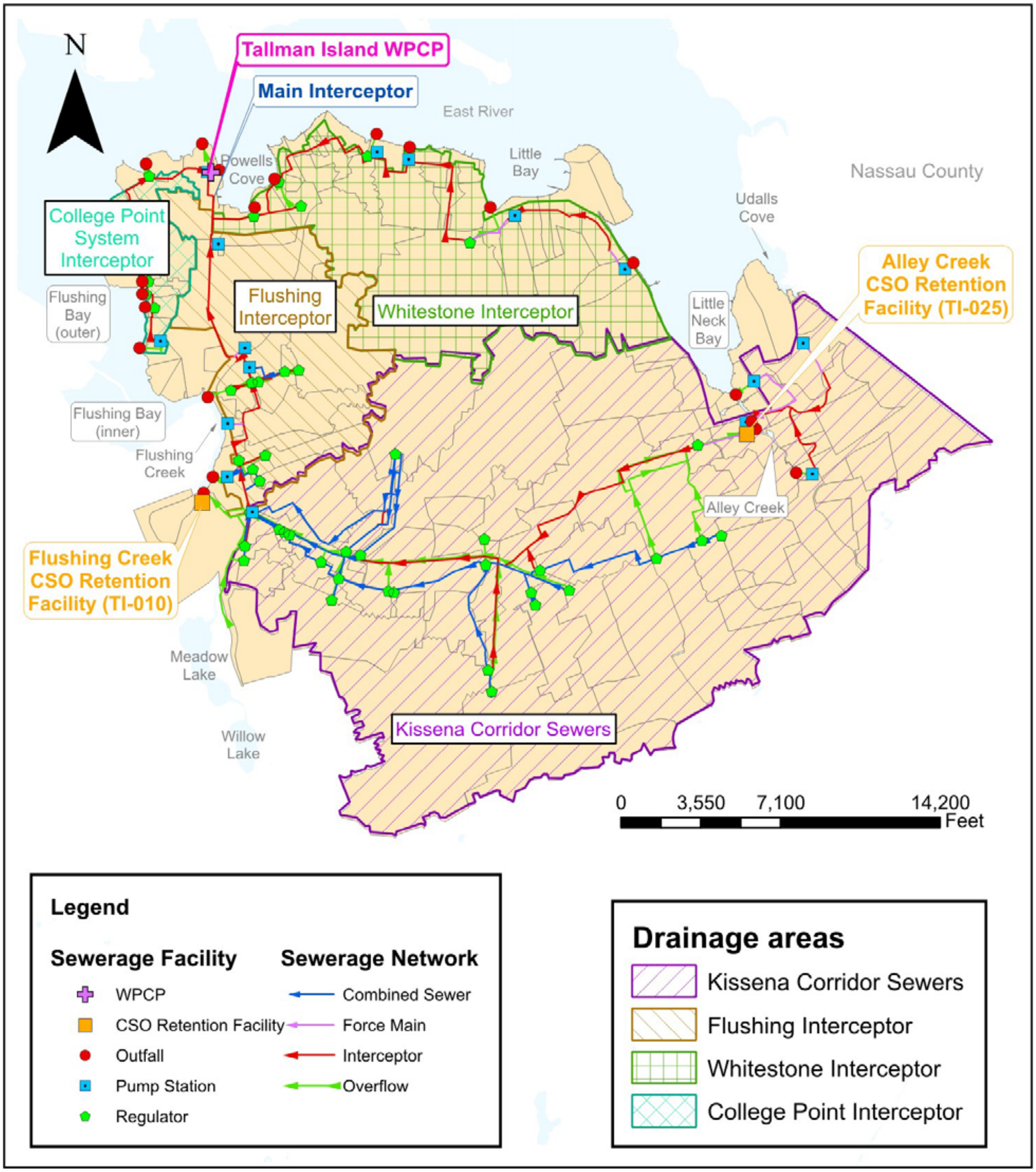
Alley Creek and Little Neck Bay Waterbody/Watershed Facility Plan

Tallman Island WPCP Sewersheds

FIGURE 3-4



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Tallman Island WPCP Principal Sewers

Alley Creek and Little Neck Bay Waterbody/Watershed Facility Plan

FIGURE 3-5

Other components of the system, also shown in Figures 3-5 and Exhibit 3-1, include the following:

- Sixteen pumping stations, five serving combined system areas, as listed in Table 3-4.
- Forty-nine combined sewer flow regulator structures, as listed in Table 3-5.
- Twenty-four CSO discharge outfalls (two of which are permanently bulkheaded), as listed in Table 3-6.

3.2.1 Combined Sewered Areas

As indicated above, the Tallman Island service area includes 8,032 acres that are served by combined sewers, plus 4,893 acres in which the sewershed is served by separate sanitary sewers and storm sewers. However, the functioning of the separately sewered systems is complicated by the configuration of the sewers downstream of the sewersheds. These systems are configured as follows:

- Flow from a relatively small portion of the separately sewered area (about 610 acres) fully maintains its separate character, with the sanitary sewage conveyed to the treatment plant without encountering intervening diversions and the stormwater discharging directly to a waterbody. These sewersheds are primarily in the area just south of Powells Cove.

- Several sewersheds along the Kissena Corridor are separately sewered inside the watershed, but the sanitary and storm sewers are then combined to be carried westward to the Flushing Interceptor at Regulator TI-R31.

- In most of the other separately sewered areas principally tributary to the Whitestone Interceptor and to the Old Douglaston Pump Station, the stormwater is conveyed directly to waterbody discharge via the municipal separate storm sewer system while the sanitary sewage is conveyed to treatment in combined trunk sewers and interceptors which have downstream overflows.

This demarcation of the separately sewered areas is depicted in Figure 3-4, and is allocated amongst the principal interceptors in Table 3-7. The Tallman Island SPDES permit CSO outfalls to Alley Creek are TI-007, TI-008, TI-009 and TI-024. CSO outfall TI-006 discharges to Little Neck Bay. The locations of Alley Creek and Little Neck Bay SPDES CSO outfalls are shown on Figure 3-6. It should be noted that TI-025 is the future CSO outfall for the Alley Creek CSO Retention Facility currently under construction.

Wet weather flows in the combined sewer system, with incidental sanitary and stormwater contributions as summarized above, results in overflows to the nearby waterbodies when the flows exceed the hydraulic capacity of the system, or the specific capacity of the local regulator structure.

Table 3-4. Tallman Island WPCP Collection System Pump Stations

	Pump Station Name	Address	Type	Cap. (MGD)	DWF (MGD)	No of Pumps	Bypass Outfall	Associated Interceptor
1	Lawrence & Peck	50-01 College Pt. Blvd.	Com.	14.00	7.10	3	None	Flushing
2	40th Road	40th Rd, West of College Pt. Blvd	San.	2.00	0.40	2	None	Flushing
3	Flushing Bridge	Lawrence St. & Northern Blvd.	San.	1.20	0.18	2	None	Flushing
4	Linden Place	Linden Pl/31st Rd.	Com.	5.00	1.89	3	None	Flushing
5	New York Times	Whitestone Exp. & Linden Place	San.	0.64		2	None	Flushing
6	122nd Street	122 St. & 28 Ave.	San.	1.50	0.31	2	TI-012; Flushing Creek	College Point
7	15th Avenue	15 Ave. & 131 St.	San.	2.90	0.22	2	None	Flushing
8	6th Road	6th Rd & 151 St.	San.	0.72	0.40	2	None	Whitestone
9	154th Street	Powells Cove Blvd. & 154 St.	Com.	2.30	0.61	3	None	Whitestone
10	Clearview	Willets Pt. Blvd, Cross-Isl. Pkwy	Com.	13.00	1.87	3	None	Whitestone
11	24th Avenue	24th Ave & 217th St.	San.	4.30	0.75	2	TI-006; Little Neck Bay	Whitestone
12	Little Neck	40th Ave. & 248th St	San.	1.40	0.26	2	None	Flushing (via Old Douglaston PS)
13	Douglaston Bay	41st Ave & 233rd St.	San.	1.00	0.07	2	TI-009; Alley Creek	Flushing (via Old Douglaston PS)
14	Old Douglaston	Parkland, Northern Blvd & 234 St.	San.	6.50	2.00	3	TI-007; Alley Creek	Flushing
15	New Douglaston	Parkland, North of LI Expressway, Cross-Isl. Pkwy	San.	3.30	0.34	2	TI-024; Alley Creek	Flushing (via Old Douglaston PS)
16	Powells Cove	Influent PS at WPCP(1)	Com.	9.3	1.00	3	None	WPCP(1)

(1) The Powells Cove Pump Station receives flow from the College Point Interceptor and pumps to the Main Interceptor. It is located on the WPCP site.

Table 3-5. Tallman Island WPCP Collection System Regulators

	Reg ID	Location	Outfall	Flow Compartment	Elev	Flow (MGD) Cap.	DWF
College Point Interceptor							
	TI-R01	College Point & 5th Ave	020	10"x10"	+ 0.47	1.93	0.24
	TI-R02	115th St & 9th Ave (Former WPCP bypass to Outfall TI-019, currently bulkheaded)					
	TI-R03	110th St & 14th Ave	018	Double 8"x 8"	- 0.75	0.74	0.11
	TI-R04	110th St & 15th Ave	017	Double 8"Dia	+ 0.35	0.73	0.05
	TI-R05	119th St & 20th Ave	016	12"x16"	- 2.20	5.84	0.67
	TI-R06	119th St & 22ndAve	015	Double 8"Dia	+ 5.18	0.81	0.09
	TI-R07	119th St & 23rd Ave	014	Double 8"Dia	+ 1.43	0.72	0.09
	TI-R08	119th St & 25th Ave	013	Double 8"Dia	+ 5.97	0.86	0.28
Whitestone Interceptor							
	TI-R10	138th St & 11th Ave (Bulkheaded; formerly 021)					
	TI-R10A	144th St & 7th Ave	003	12" Dia	+ 8.50	30.34	N/A
	TI-R10B	144th St E/O Malba Ave	003	18"x12"	+10.00	> 1.09	0.89
	TI-R11	151st St & 7th Ave	004	12"x12"	+17.50	4.47	0.27
	TI-R12	154th St & Powells Coge Ave	005		- 0.50	6.54	0.54
	TI-R13	15th Dr & Willets Point Blvd	023	24"x18"	+24.65	12.78	2.81
Flushing Interceptor							
	TI-R09	Linden Place & 32nd Ave	011	60"Dia.	+ 4.50	103.40	32.56
	TI-R51	Parsons Blvd & 32nd Ave	011	24"x24"	+16.35	5.12	1.72
	TI-R52	Union St & 32nd Ave	011	12"x12"	+ 8.00	1.78	0.16
	TI-R53	137th St & 32nd Ave	011	12"x12"	+ 2.75	2.41	0.54
	TI-R54	Downing St & 32nd Ave	011	12"x12"	+ 0.50	2.68	0.22
	TI-R55	College Pt Blvd & Roosevelt Ave	022	12"x12"	+10.80	2.89	0.70
	TI-R56	Main St & 40th Rd	022	24"x24"	+12.50	7.23	2.55
	TI-R57	41st Ave E/O Lawrence St	022	12"x12"	+ 8.72	1.34	0.41
	TI-R58	Sanford Ave & Frame St	022	15"x15"	+21.10	2.67	1.16
	TI-R59	58th Ave & Lawrence St	010	24"x36"	+14.68	29.71	0.27
	TI-R60	Booth Mem Pkwy & Lawrence St	010	Orifice	+13.00	27.47	0.64
Kissena Corridor Trunk Sewers Upstream of TI-R31							
	TI-R29	Oak Ave & Colden St	010	12"x12"	+ 5.50	3.74	2.80
	TI-R30	Quine Ave & Kissena Blvd	010	9"x 33"	+ 1.88	5.45	2.10
	TI-R31	Lawrence St & Blooson Ave	010	18"Dia	+12.00	113.19	N/A
	TI-R32	137th St & Peck Ave	010	8"Dia	+13.68	0.21	0.01
	TI-R33	138th St & Peck Ave	010	8"Dia	+13.68	0.72	0.03
	TI-R34	Main St S/O Peck Ave	010	8"Dia	+13.88	0.61	0.04
	TI-R35	56th Rd & 146th St	010	10"Dia	+21.25	6.74	0.06
	TI-R36	150th St & Booth Mem Pkwy	010	Orifice		> 3.47	2.34
	TI-R37	150th St & 60th Ave	010	24"Dia	+16.40	5.47	2.04
	TI-R38	Parsons Blvd & Booth Mem Pkwy	010	8"Dia	+18.66	N/A	0.02
	TI-R39	159th St & Booth Mem Pkwy	010	18"Dia	+20.25	6.71	0.12

Table 3-5. Tallman Island WPCP Collection System Regulators

	Reg ID	Location	Outfall	Flow Compartment	Elev	Flow (MGD) Cap.	Flow (MGD) DWF
	TI-R40	Fresh Meadow La & Peck Ave	010	36"x28"	+19.05	24.31	5.00
	TI-R40A	Gladwin Ave & Fresh Meadow La	010	12"x12"	+34.10	3.57	0.04
	TI-R41	188th St & LIE (N.S.)	010	27"Dia	+24.75	7.79	0.91
	TI-R42	188th St & LIE (S.S.)		Orifice	+27.08	> 1.28	0.86
	TI-R43	192nd St & 56th Ave	010	36"Dia	+25.90	18.15	3.25
	TI-R44	Peck Ave & LIE (S.S.)	010		+31.00	3.09	0.30
	TI-R45	73rd Ave & Utopia Pkwy	010	Orifice	+25.00	12.62	1.33
	TI-R45A	69th Ave & Fresh Meadow La	010	Orifice		> 6.54	4.41
	TI-R46	210th St & LIE (N.S.)	008	30"Dia	+51.10	15.91	2.54
	TI-R47	218th St & LIE (N.S.)	008	Orifice	+69.40	12.48	0.61
	TI-R48	Springfield Blvd & LIE (S.S.)	Internal	12"Dia	+75.92	> 0.34	0.23
	TI-R49	220th Pl & 46th Ave	008	12"Dia	+44.50	1.57	0.23
	TI-R50	157th St & 43rd Ave	Internal	24" Dia	+24.50	4.97	2.56

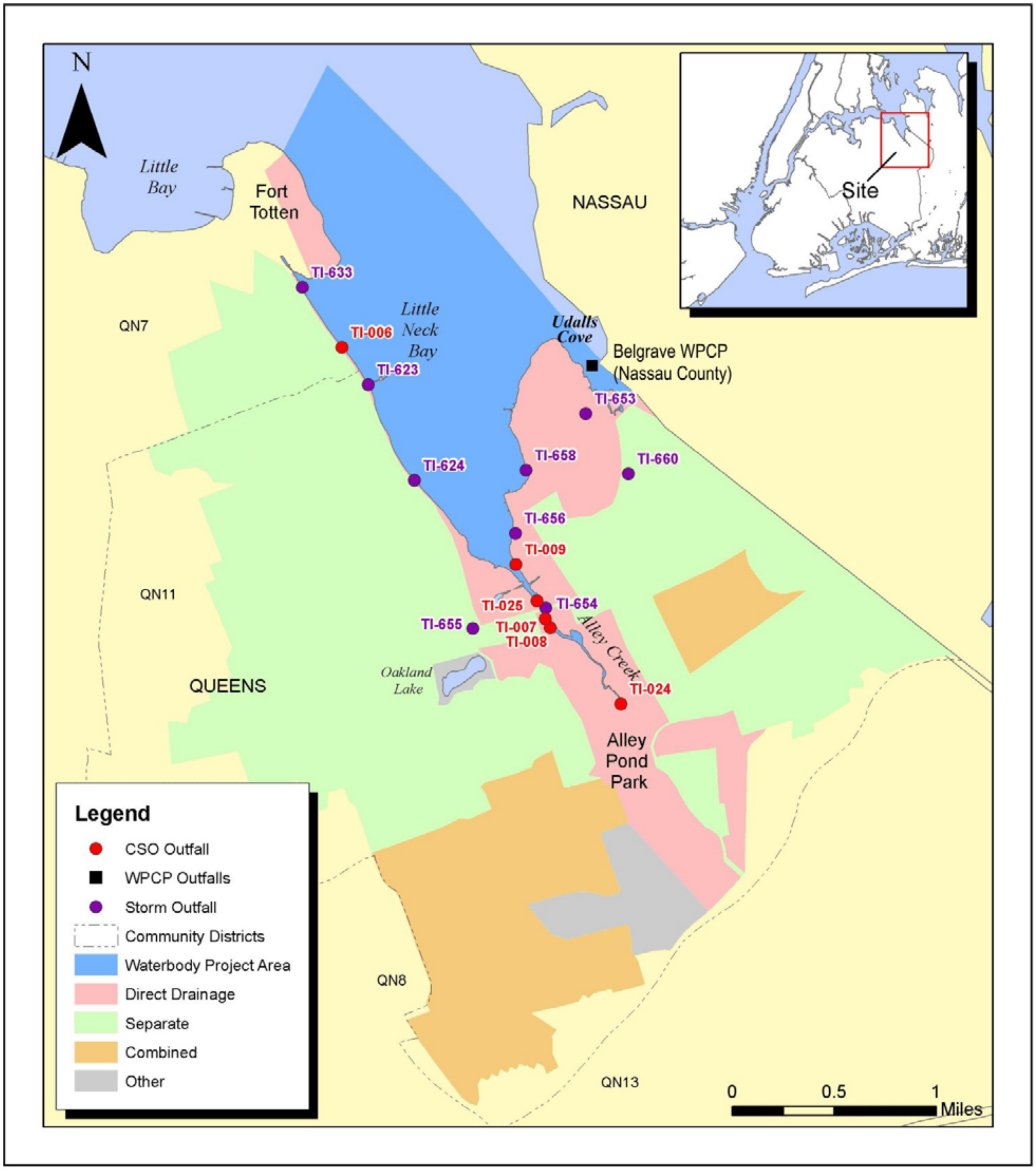
Table 3-6. Tallman Island WPCP Collection System Outfalls

Outfall	Location / (Regulator)	Size	Waterbody /Class	Comment
002	Treatment Plant Bypass	60" DIA	East River / SB	(Outfall bulkheaded, and outfall deleted from 2005 SPDES permit)
003	n/o 7th Ave. (REG #10A)	8'-0" x 8'-0"	Powells Cove / I	
004	151st Street (REG # 11)	72" DIA	East River / SB	
005	154th Street (REG # 12)	24" DIA	East River / SB	
006	24th Avenue	10'-0" x 7'-6"	Little Neck Bay /SB	24th Ave P.S. Bypass(1)
007	Northern Blvd (Old Douglaston. P.S.)	18" DIA	Alley Creek / I	Old Douglaston P.S. Bypass(1)
008	46th Ave. (REG# 46, 47, 48, 49)	10' x 7'-6"	Alley Creek / I	Telemetered (46, 47, & 49)
009	Douglaston Bay P.S	2x8"	Alley Creek / I	Douglaston Bay P.S. Bypass(1)
010	Pending Flushing Bay CSO Retention Facility, Roosevelt Ave. (REG #29-40, 40A, 41-45, 45A, 50, 59, 60, BB Reg #14, 15,27, 27A, 28)	3BL 18' x 10'	Flushing Creek / I	Telemetered (30, 40), Boom
011	32nd Ave. (REG # 9, 51 - 54)	DBL 8' x 8'	Flushing Creek / I	Telemetered (9), Net
012	29th Ave.	12" DIA	Flushing Creek / I	122nd P.S. Bypass(1)
013	25th Avenue (REG # 8)	18" DIA	Flushing Bay / I	
014	23rd Avenue (REG # 7)	12" DIA	Flushing Bay / I	
015	22nd Avenue (REG # 6)	1'-3" x 1'-10"	Flushing Bay / I	
016	20th Avenue (REG # 5)	60" DIA	Flushing Bay / I	
017	15th Avenue (REG # 4)	12" DIA	Flushing Bay / I	
018	14th Avenue (REG # 3)	1'-6" x 1'-2"	Flushing Bay / I	
019	9th Ave. (REG #2)	12" DIA	East River / I	
020	College Place (REG #1)	24" DIA	East River / I	
021	233rd Street (REG #10)	42" DIA	Powells Cove / I	(Connection from Reg #10 now bulkheaded; outfall deleted from 2005 SPDES permit as a CSO outfall)
022	40th Rd (REG #55-58)	7' x 6'-6"	Flushing Creek / I	Boom
023	Cryders Lane (REG #13)	13'6" x 8'	Little Bay / SB	Telemetered
024	61st Avenue	12' x 10' Box	Alley Pond / I	New Douglaston P.S. Bypass(1)
025	Alley Creek CSO Storage Facility (future)	52'6" x 7'6"	Alley Creek / I	

(1) SPDES permits list sanitary pump station bypasses as CSO outfalls. These outfalls only overflow during emergency situations and do not normally overflow.

Table 3-7. Interceptor Drainage Areas

Interceptor	Length (feet)	Total Area (acres)	Combined (acres)	Separate (acres)
Main *(receives flow from Flushing and Whitestone interceptors)*	2,238	76	0	76
Flushing *(receives flow from areas downstream and upstream of TI-R31 and from Old Douglaston Pump Station)*	79,422	10,001	6,616	3,384
Flushing downstream of TI-R31	*15,507*	*1,387*	*974*	*413*
Trunk Sewers upstream of TI-R31	*63,915*	*7,274*	*5,512*	*1,761*
Old Douglaston Pump Station (upstream of Trunk Sewers)	*N/A*	*1,340*	*130*	*1,210*
College Point	12,744	375	310	66
Whitestone	23,104	2,473	1,106	1,367
Interceptor Subtotal	117,508	12,925	8,032	4,893
Other	N/A	2,171	0	0
Total Tallman Island WPCP Drainage Area	**117,508**	**15,096**	**8,032**	**4,893**



New York City
Department of Environmental Protection

Alley Creek/Little Neck Bay
SPDES Permitted Outfalls

Alley Creek and Little Neck Bay Waterbody/Watershed Facility Plan

FIGURE 3-6

3.2.2 Stormwater Outfalls

The Tallman Island SPDES discharge permit includes a list of permitted stormwater outfalls for the WPCP. The outfalls specified in the permit are listed in Table 3-8.

The nine permitted stormwater outfalls discharging to Alley Creek and Little Neck Bay are TI-623, TI-624, TI-633, TI-653, TI-654, TI-655, TI-656, TI-658, and TI-660. The locations of these SPDES permit stormwater outfalls are shown in Figure 3-6. It should be noted that TI-006 and TI-024, although permitted as CSO outfalls, only discharge stormwater.

3.2.3 Non-sewered Areas

For several sections of the Tallman Island WPCP drainage area, stormwater drains directly to receiving waters without entering the combined sewer system. These areas are depicted as "Direct drainage" or "On-site septic" in Figure 3-4 and were delineated based on topography and the resultant direction of stormwater sheet flow in those areas. In general, shoreline areas adjacent to waterbodies comprise the direct drainage category. Significant "direct drainage" areas include Fort Totten, Douglaston Manor, and Alley Pond Park, all of which are tributary to the Alley Creek and Little Neck Bay waterbodies. In addition, the northern portion of Douglaston Peninsula, as indicated in Figure 3-4, is served by individual septic systems. These septic systems are a potential source of pollutants to adjacent Little Neck Bay waters.

"Other" areas are largely comprised of parkland, such as portions of Flushing Meadows Corona Park, Kissena, Cunningham, and Clearview Parks, and Mt. Hebron and Flushing Cemeteries. These areas are depicted as "other" drainage areas in Figure 3-4. The "other" category also includes special cases, such as the former Flushing Airport in College Point (now a commercial distribution center), where sanitary flow is conveyed to the WPCP and stormwater is most likely conveyed through stormwater collection systems to receiving waters. The named areas above are generally outside the Alley Creek and Little Neck Bay watershed. The "other" areas that are attributed to drain to Alley Creek, Oakland Lake and an area in the headwaters of Alley Creek, are shown in Figure 1-2.

Overall, the "direct drainage" and "other" areas cover roughly 3,654 acres of the Tallman Island WPCP, 1,484 and 2,170 acres, respectively. In the Alley Creek and Little Neck Bay, the "direct drainage" and "other" areas are 828 acres and 192 acres, respectively, totaling 1,020 acres.

3.3 NASSAU COUNTY DRAINAGE

Areas on the Great Neck Peninsula drain to Little Neck Bay and Manhasset Bay in Nassau County. The WPCP Districts located in Nassau County are shown in Figure 3-2. The Nassau County systems shown (Belgrave, Village of Great Neck and the Great Neck Water Pollution Control District) are separately sewered and therefore, no CSO is discharged. The stormwater from these districts drains to Little Neck Bay, the East River and Manhasset Bay as shown in Figure 3-7.

Table 3-8. Municipal Separate Storm Sewer System Outfalls

Outfall	Latitude	Longitude	Location	Size	Waterbody
601	40,45,46	73,50,05	Northern Blvd. (south side)	30" DIA	Flushing Creek
603	40,45,46	73,50,05	Northern Blvd. (north side)	27" DIA	Flushing Creek
605	40,45,54	73,50,28	300' w/o Whitestone Expwy.	6'9" x 4'11"	Flushing Creek
609	40,47,00	73,50,50	121st St.	36" DIA	East River
610	40,47,00	73,49,29	147th St.	48" DIA	East River
611	40,47,00	73,48,27	w/o 154th St.	48" DIA	East River
612	40,47,00	73,48,27	w.o 154th St.	48" DIA	East River
615	40,47,00	73,47,25	9th Ave.	12" DIA	Little Bay
616	40,47,29	73,47,43	12th Ave.	12" DIA	Little Bay
617	40,47,00	73,47,25	12th Rd.	12" DIA	Little Bay
618	40,47,33	73,47,25	14th Ave.	10" DIA	Little Bay
619	40,47,32	73,47,22	Cryders Lane	12" DIA	Little Bay
623*	40,46,45	73,46,05	28th Ave.	18" DIA	Little Neck Bay
624*	40,46,22	73,45,50	35th Ave.	11' x 3'4"	Little Neck Bay
631	40,46,02	73,50,24	31st Rd.	54" DIA	Flushing Creek
633*	40,47,11	73,46,28	s/o 17th Ave.	54" DIA	Little Neck Bay
634	40,47,32	73,47,05	Fort Totten South Jetty	18" DIA	Little Bay
653*	40,45,40	73,45,06	Sandhill Rd.	48" DIA	Udalls Cove
654*	40,45,48	73,45,07	20' n/o Northern Blvd.	36" DIA	Alley Creek
655*	40,45,52	73,45,06	223rd St. & Northern Blvd.	15" DIA	Alley Creek
656*	40,46,01	73,45,02	39th Ave.	36" DIA	Frank Turner Inlet
658*	40,46,01	73,45,02	233rd Place	40" DIA	Little Neck Bay
660*	40,46,23	73,44,39	39th Ave. & 248th St.	12" DIA	Udalls Cove
661	40,47,25	73,47,05	208th St.	30" DIA	Little Bay
665	40,46,22	73,45,15	131st St.	72" DIA	East River
666	40,47,24	73,51,18	9th Ave.	18" DIA	East River
669	40,50,46	73,51,05	15' s/o 31st Rd.	24" DIA	Flushing Creek
670	40,47,43	73,51,58	100' n/o North Shore M.T.S.	60" DIA	Flushing Bay
671	40,47,23	73,51,23	w/o 8th Ave.	36" DIA	East River
672	40,47,01	73,51,32	50' n/o 111th St.	30" DIA	Flushing Bay
* Discharge to Alley Creek or Little Neck Bay.					

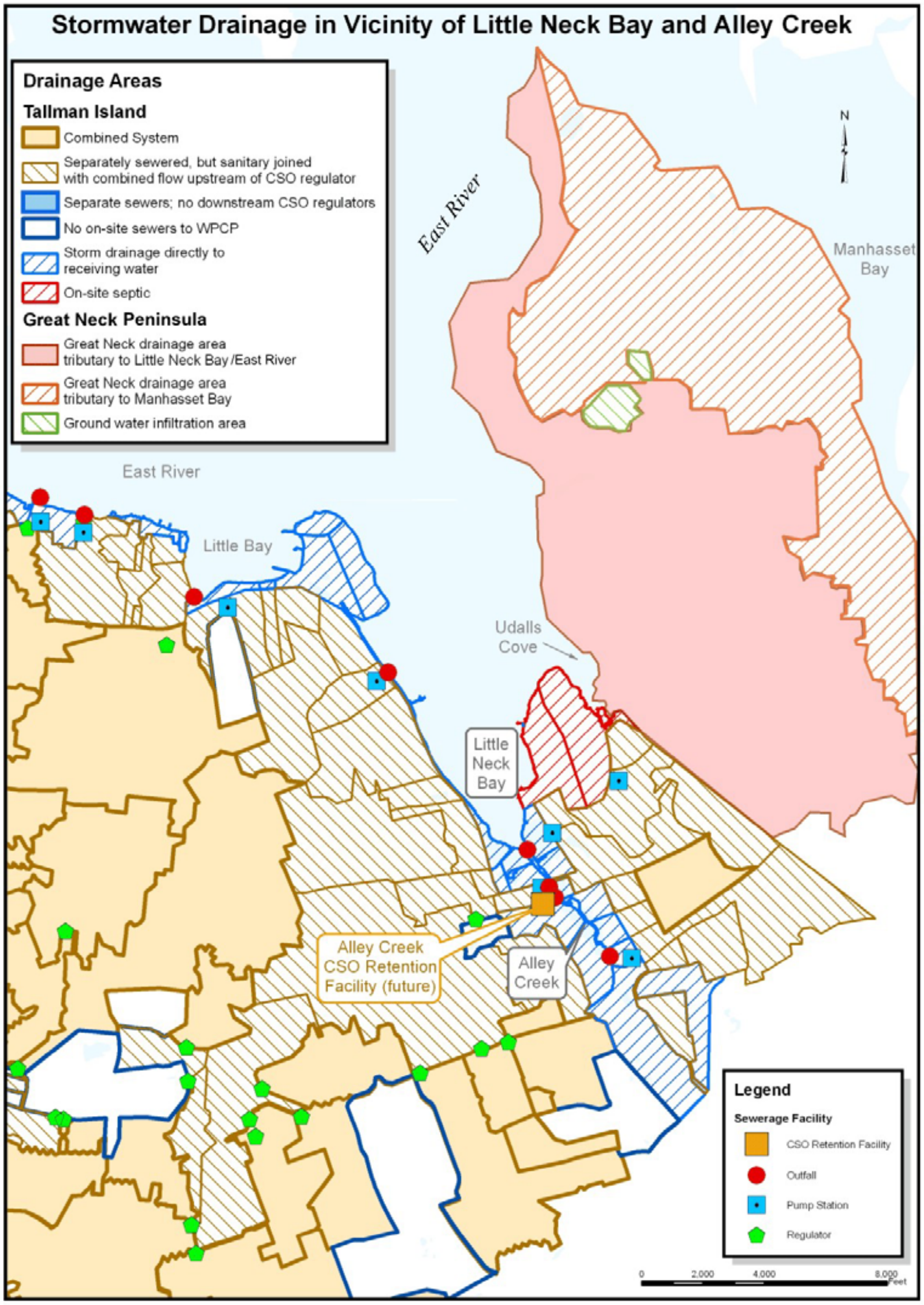
3.4 SEWER SYSTEM MODELING

Mathematical watershed models are used to simulate the hydrology (rainfall induced runoff) and hydraulics (sewer system responses) of a watershed, and are particularly useful in characterizing the sewer system conditions during wet weather and in evaluating engineering alternatives on a performance basis. In the hydrology portion of the model, climatic conditions (such as hourly rainfall intensity) and physical watershed characteristics (such as slope, imperviousness, and infiltration) are used to calculate rainfall-runoff hydrographs from individual smaller drainage areas (subcatchments) that drain runoff into catch basins. These runoff hydrographs are then applied at corresponding locations (manholes) in the sewer system as inputs to the hydraulic portion of the model. In the hydraulic portion, the resulting hydraulic grade lines and flows are calculated based on the characteristics and physical features of the sewer system, such as pipe sizes, pipe slopes, and flow-control mechanisms like weirs and pumping stations. Model output includes sewer system discharges which, when coupled with pollutant concentration information, provide the pollutant loadings necessary for receiving-water models to assess the water quality impacts. The following generally describes the tools employed to model the drainage areas tributary to Alley Creek and Little Neck Bay. A more detailed description of the model setup, calibration and model projection processes are provided under separate cover *City-Wide LTCP Landside Modeling Report, Tallman Island Water Pollution Control Plant (WPCP).*

3.4.1 InfoWorks CS™ Modeling Framework

The hydraulic modeling framework used in this effort is a commercially available, proprietary software package called InfoWorks CS™, developed by Wallingford Software, U.K. InfoWorks CS™ is a hydrologic/ hydraulic modeling package capable of performing time-variant simulations in complex urban settings for either individual rain events or long-term periods comprising many rain events. The outputs include calculated hydraulic grade lines and flows within the sewer system network and at discharge points. InfoWorks CS™ solves the complete St. Venant hydraulic routing equations representing conservation of mass and momentum for sewer-system flow and accounts for backwater effects, flow reversals, surcharging, looped connections, pressure flow, and tidally affected outfalls. Similar in many respects to the USEPA Storm Water Management Model (SWMM), InfoWorks CS™ offers a state-of-the-art graphical user interface with greater flexibility and enhanced post-processing tools for analysis of the model generated outputs. In addition, InfoWorks CS™ utilizes a four-point implicit numerical solution technique that is generally more stable than the explicit solution procedure used in SWMM. The NYCDEP has chosen InfoWorks CS™ as the unified platform for developing urban drainage models for all the 14 WPCP drainage areas in the city.

Model input for InfoWorks CS™ includes watershed characteristics for individual subcatchments, including area, surface imperviousness and slope, as well as sewer-system characteristics such as information describing the network (connectivity, pipe sizes, pipe slopes, pipe roughness, etc.) and flow-control structures (pump stations, regulators, outfalls, and WPCP headworks). Hourly rainfall patterns and tidal conditions are also important model inputs. InfoWorks CS™ allows interface with geographic information system (GIS) data to facilitate model construction and analysis.



New York City
Department of Environmental Protection

Great Neck Peninsula Drainage

Alley Creek and Little Neck Bay Waterbody/Watershed Facility Plan

FIGURE 3-7

Model output includes flow and hydraulic gradient line (HGL) at virtually any point in the modeled system and also at virtually any time during the modeled period. InfoWorks CS™ provides full interactive views of data using geographical plan views, longitudinal sections, spreadsheet-style grids and time-varying graphs. A three-dimensional junction view provides an effective visual presentation of hydraulic behavior in manholes during wet or dry weather periods. Additional post-processing of model output allows the user to view results in various ways as necessary to evaluate the system response, and also to visualize the improvements resulting from various engineering alternatives.

3.4.2 Application of the Model to Tallman Island Collection System

The InfoWorks CS™ model for the Tallman Island Collection System was constructed using information and data compiled from the NYCDEP inflow/infiltration drawings, as-built or construction drawings, WPCP data including wet well configuration, previous and ongoing planning projects, regulator improvement program reports, and inflow/ infiltration analyses in separately sewered portions of the drainage area. This information includes invert and ground elevations for manholes, pipe dimensions, pumping station characteristics, and regulator configurations and dimensions.

Model simulations include WPCP headworks, interceptors, branch interceptors, major trunk sewers, all sewers greater than 48-inches in diameter plus other smaller, significant sewers, and control structures such as pump stations, diversion chambers, tipping locations, reliefs, regulators, and tide gates. As presented in the LTCP Landside Modeling Report for Tallman Island drainage area, the model was calibrated and validated using flow and hydraulic-elevation data collected historically in this area. All CSO and stormwater outfalls permitted by the State of New York are represented in the model, with stormwater discharges from separately sewered areas simulated using separate models, as necessary. The runoff generated and discharged directly from areas adjoining the receiving waters (direct drainage) is modeled separately. Similarly, runoff generated and discharged directly from tributary areas not adjoining the receiving waters ("other") is also modeled separately.

Some portions in the eastern part of the Tallman Island drainage area have been designed to be separately sewered. The NYCDEP built sanitary sewers, and is building storm sewers as part of the on-going sewer master planning process. In the interim, seepage pits (consisting of a concrete cylinder inside 10-12 feet of graded sand layers) have been built in some areas to capture storm runoff. In other areas, catch basins have been temporarily connected to sanitary sewers to relieve street flooding while in other areas runoff flows along street curbs downgradient until it reaches a catch basin or a seepage pit. Although these features were not explicitly included in the model, the model calibration process accounted for runoff reductions expected from the seepage pits through adjustments to the impervious cover.

Conceptual alternative scenarios representing no-action (baseline) and other alternatives were simulated for the average year (1988 JFK rainfall). Tidal influence on the outfalls was explicitly modeled using the tidal boundary conditions and tide gates, where present. Depending on the number of regulators that contributed flows to each outfall, the discharges from those regulators were combined to develop the total discharges on a time-variable basis. The fractions of sanitary flows and storm water at each time-step were determined using the pollutant routing algorithm built in InfoWorks CS™. Pollutant concentrations selected from field data and best professional judgment were assigned to the sanitary and stormwater components of the combined sewer discharges to calculate variable pollutant loadings. Similar assignments were made for stormwater discharges in separated areas or to flows discharged from direct drainage and “other” areas. Discharges and pollutant loadings were then post-processed and used as inputs to the receiving-water model, described in Section 4.

3.4.3 Application of the Model to Nassau County

The drainage areas that contribute runoff from Nassau County, shown in Figure 3-6, were explicitly modeled in InfoWorks CS^{TM}, as separately sewered areas. Pollutant concentrations selected from field data and best professional judgment were assigned to Nassau County stormwater. Discharges and pollutant loadings were then post-processed and used as inputs to the receiving-water model, described in Section 4.

3.4.4 Baseline Design Condition

Watershed modeling can be an important tool in evaluating the impact of proposed physical changes to the sewer system and/or of proposed changes to the operation of the system. In order to provide a basis for these comparisons, a “Baseline Condition” was developed. For the Tallman Island Model, the Baseline Conditions parameters were as follows:

1. Dry weather flow rates reflect year 2045 population projections, 60.2 MGD sanitary flow.

   Establishing the future Tallman Island WPCP dry weather sewage flow is a critical step in the WB/WS Facility Planning analysis since one key element in the City’s CSO control program is the use of WPCPs to reduce CSO events. Increases in sanitary sewage flows associated with increased populations will reduce the amount of CSO flow that can be treated at the existing WPCPs since the increased sewage flows will use part of the WPCP wet weather capacity.

   Dry weather sanitary sewage flows used in the baseline modeling were escalated from current levels to reflect anticipated growth within the City. The Mayor’s Office and City Planning have made assessments of the growth and movement of the population between the year 2000 census and 2010 and 2030 (NYCDCP, 2006). This information is contained in a set of projections made for some 188 neighborhoods within the city. NYCDEP has escalated these populations forward to 2045 by assuming the rate of growth between 2030 and 2045 could be 50 percent of the rate of growth between 2000 and 2030 (NYCDCP, 2006). These populations were associated with each of the landside modeling sub-catchment areas tributary to each CSO regulator using GIS calculations. Dry sanitary sewage flows were then calculated for each of these sub-catchment areas by associating a conservatively high per capita sanitary sewage flow with the population estimate. The per capita sewage flow was established as the ratio of the year 2000 dry weather sanitary sewage flow and population for the Tallman Island WPCP service area.

   Increasing the dry weather sewage flows for the Tallman Island WPCP from the current (fiscal year 2005) flow of 53 MGD to a 2045 estimated flow of 60.2 MGD will properly account for the potential reduction in wet weather treatment capacity associated with projections of a larger population.

2. Tallman Island WPCP wet weather capacity of 122 MGD.

The baseline wet weather capacity for this and all other WB/WS Facility Plans has been set to the 2003 wet weather "average sustained flow" consistent with the calculations of wet weather capture and performance in the "White Paper" appended to the 2005 CSO Consent Order. The average sustained flow is the average of the largest, multi-hour flows that occurred during each of the top ten storm periods. The sustained flows are determined by averaging the hourly persistent maximum flow over the storm period. The average sustained flows are reported annually to NYSDEC in the Combined Sewer Overflow Best Management Practices (BMP) Annual Report. For the Tallman Island WPCP the average sustained 2003 wet weather flow is 122 MGD (NYCDEP, 2004).

3. Documented sedimentation in sewers.

Sediment was included in the Tallman Island collection system in recognition of the fact that operation without any sediment is not the reality of experience in the field. Therefore, sediment was included. The sediment does not represent a chronic condition in need of remediation but rather a normal condition. It should be noted that the same sedimentation is included in the alternatives evaluation scenarios. The sedimentation is the same in the Baseline and Facility Plan analyses.

4. Rainfall record is 1988 from JFK.

In addition to the above watershed/sewer system conditions, long-term meteorological (rainfall) conditions are necessary for comparing the benefits of various engineering alternatives in the Tallman Island drainage area. In accordance with the Federal CSO Control Policy, the concept of identifying an average rainfall year was used. Long-term rainfall records measured in the New York City metropolitan area were analyzed to identify potential rainfall design years to represent long-term, annual average conditions. Statistics were compiled to determine:

- Annual total rainfall depth
- Annual total number of storms
- Annual average storm volume
- Annual average storm intensity
- Annual total duration of storms
- Annual average storm duration, and
- Annual average time between storms

A more detailed description of the comparative rainfall analyses is provided in a previous report (HydroQual, 2004). Although no year was found having the long-term average statistics for all of these parameters, the rainfall record measured at the National Weather Service gage at John F. Kennedy (JFK) International Airport during calendar year 1988 is representative of the overall, long-term average conditions in terms of the annual total rainfall and storm duration. Table 3-9 summarizes some of the statistics for 1988 and a long-term (1970-2002) record at JFK. Furthermore, the JFK 1988 rainfall record also includes high-rainfall conditions during July (recreational) and November (shellfish) periods, which is useful for evaluating the potential CSO impacts on water quality during those stressing periods. As a result, the JFK 1988 rainfall record was selected as an appropriate design condition for which to evaluate the baseline and future sewer system responses to rainfall. The JFK 1988 record has also been adopted as design condition by the New York Harbor Estuary Program to evaluate water-quality conditions in the New York/New Jersey Harbor Estuary.

Table 3-9. Comparison of Annual 1988 and Long-Term Statistics JFK Rainfall Record (1970-2002)

Rainfall Statistic	1988 Statistics	Long-Term Median (1970-2002)
Annual Total Rainfall Depth (inches)	40.7	39.4
Return Period (years)	2.6	2.0
Average Storm Intensity (inch/hour)	0.068	0.057
Return Period (years)	11.3	2.0
Annual Average Number of Storms	100	112
Return Period (years)	1.1	2.0
Average Storm Duration (hours)	6.12	6.08
Return Period (years)	2.1	2.0

3.5 CHARACTERISTICS OF DISCHARGES TO ALLEY CREEK AND LITTLE NECK BAY

As indicated in Section 3.4, sewer-system modeling is useful to characterize flows and pollutant loads discharged from various outfalls in the drainage area. Because long-term monitoring of outfalls is difficult and expensive, and sometimes not accurate in tidally influenced or submerged outfalls, sewer-system models that have been calibrated to available measurements of water levels and flows can offer a useful characterization of the discharge quantities. Sewer system models can also be used to estimate the overflow quality through a variety of calculation methods. In this study, relative percentage of sanitary sewage and rainfall runoff discharged from a CSO point at any given time was used as a way to estimate the CSO quality during the continuous simulation period. This is particularly helpful when developing pollutant concentrations, since this sanitary/runoff split for discharge volume can be used to develop pollutant loadings based on concentrations associated with the sanitary and runoff volumes. Concentrations based on discharge fractions of sanitary versus runoff are somewhat more reliable than concentrations assigned based on pollutant concentrations measured in combined sewage (e.g., the event mean concentrations, EMC), which are particularly variable. Concentrations based on discharge fractions also allow for the dilution of sanitary sewage that is observed in CSO overflows during larger rainfall events.

Section 3.5.1 presents information related to the quantity (volume) discharged into the waterbody for the Baseline condition. Section 3.5.2 discusses the pollutant concentrations assigned to the storm and sanitary discharges. Section 3.5.3 summarizes the pollutant loadings discharged to Alley Creek and Little Neck Bay for the Baseline Condition. Section 3.5.4 discusses the potential for toxic discharges to Alley Creek and Little Neck Bay, and Section 3.5.5 provides an overview of the effect of watershed development and urbanization on discharges.

3.5.1 Characterization of Discharged Volumes, Baseline Condition

The calibrated watershed models described in Section 3-4 were used to characterize discharges to Alley Creek and Little Neck Bay for the Baseline Condition.

TI-006: As listed in Table 3-6, TI-006 is the 24th Avenue Pump Station bypass that discharges to Little Neck Bay. This bypass is rarely needed and the Tallman Island Model Baseline indicated no CSO flow from this outfall. However, stormwater from separately sewered areas enters the outfall pipe downstream of the pump station bypass and is discharged through TI-006. During the Baseline one-year simulation period, a total of 109 MG was calculated to overflow from this outfall. Although discharging from TI-006, this flow is stormwater and is designated as “Stormwater Discharge via CSO Outfall” to distinguish this source from stormwater discharged via stormwater outfalls, direct drainage and “other” areas.

TI-007: As listed in Table 3-6, TI-007 is the Old Douglaston Pump Station bypass that discharges into Alley Creek. This bypass is rarely needed and the Tallman Island Model Baseline indicated no CSO flow from CSO outfall TI-007. No stormwater is discharged from TI-007 during Baseline. This outfall is to be demolished during the Alley Creek project as mandated by NYSDEC, thus eliminating the emergency overflow from the Old Douglaston Pump Station. Collection System Operations will monitor from a telemetry system and respond to any alarms.

TI-009: As listed in Table 3-6, TI-009 is the Douglaston Bay Pump Station bypass that discharges into Alley Creek. This bypass is rarely needed and the Tallman Island Model Baseline indicated no CSO flow from CSO outfall TI-009. No stormwater is discharged from TI-009 during Baseline.

TI-024: As listed in Table 3-6, TI-024 is the new Douglaston Pump Station bypass that discharges into Alley Creek. This bypass is rarely needed and the Tallman Island Model Baseline indicated no CSO flow from CSO Outfall TI-024. Similarly to TI-006, TI-024 carries stormwater from separately sewered areas that enters the pipe downstream of the bypass and is discharged through the CSO outfall TI-024. This stormwater is designated as “Stormwater Discharge via CSO Outfall” to distinguish this source from stormwater discharged via stormwater outfalls, direct drainage and “other” areas. During the Baseline one-year simulation period, a total of 120 MG of stormwater was calculated to be discharged from this outfall.

TI-008: TI-008 is the CSO outfall for Regulators 46, 47, 48, and 49. TI-008 discharges to Alley Creek (Table 3-6). TI-008 discharges CSO from these regulators as well as stormwater from separately sewered areas. This stormwater becomes mixed with the CSO. A total of 517 MG of mixed CSO and stormwater is calculated to be discharged from TI-008 during the Baseline one-year simulation period. Of this total discharge, 58.8 MG is CSO, 4.4 MG sanitary component and 54.4 MG stormwater component. Downstream of the regulators an additional 458.6 MG of stormwater from separately sewered areas enters the pipe for discharge at TI-008, a total CSO of 517 MG.

Table 3-10 summarizes the results with statistics relating the annual CSO and stormwater discharges from each point-source outfall for the Baseline Condition from the Tallman Island CSO outfalls that discharge to Alley Creek and Little Neck Bay. About 69 percent of the total annual volume discharged from Tallman Island outfalls, under 1988 Baseline Conditions, is from combined sewer overflows (TI-008), and the remaining from stormwater outfalls (TI-006 and TI-024).

Table 3-10. Tallman Island CSO Outfall Discharge Summary for Baseline Condition for Alley Creek and Little Neck Bay(1)

Combined Sewer Outfall	Water Body	Stormwater Discharged via CSO Outfalls (MG) (2)	CSO Discharge Volume (MG)	% of Total Volume	Annual Frequency of CSO Discharge
TI-007	Alley Creek	0	0	0	-
TI-008	Alley Creek	0	517(3)	69	38
TI-009	Alley Creek	0	0	0	-
TI-024	Alley Creek	120	0	16	-
TI-006	Little Neck Bay	109	0	15	-
Totals		**229**	**517**	**100**	**38**

(1) Baseline condition reflects design precipitation record (JFK, 1988), projected sanitary flows for year 2045, Tallman Island WPCP capacity at 122 MGD.
(2) Discharge via CSO outfall that is only stormwater
(3) Includes 58.8 MG CSO and 458.6 MG stormwater.

Tallman Island Service Area Stormwater, Direct Drainage, and "Other" Drainage Discharges: The Tallman Island Model, as described above, was used to calculate discharge contributions from stormwater runoff sources for Baseline Condition. These flows are stormwaters that are discharged via stormwater outfalls or that flow directly to the waterbody. Drainage from "Other" areas is accounted for by including the flow in the stormwater outfalls to which it has been routed in the Tallman Island Model. For analysis purposes and in summary tables, Tallman Island service area stormwater, direct drainage and drainage from "other" areas are totaled and called "Stormwater and Direct Runoff." Tallman Island stormwater and direct drainage for Baseline is 321 MG into Alley Creek and 577 MG into Little Neck Bay for a total Baseline Condition of 898 MG (Stormwater and Direct Runoff).

Nassau County Flows: There are no CSO discharges from Nassau County WPCPs. The Nassau County areas that drain to Little Neck Bay contribute stormwater and direct runoff, but do not contribute CSOs. The Baseline Condition for Nassau County stormwater and direct runoff is 893 MG. In addition, the flow discharged by the Belgrave WPCP, 475 MG, is included in the Baseline Condition loading analysis. Table 3-11 summarizes all the sources of flow to Alley Creek and Little Neck Bay for the Baseline Condition year.

Table 3-11. Alley Creek and Little Neck Bay Discharge Flow Summary, Baseline Condition Year

Source	Discharge Volume (MG)	Percent of Total Volume
Tallman Island CSO	517[(1)]	17
Tallman Island Stormwater Discharged via CSO Outfalls	229	8
Tallman Island Stormwater Direct Drainage, Other	898	30
Nassau County Stormwater	893	30
Belgrave WPCP, Nassau County	475	15
Total	3,012 MG	100%

[(1)] Includes 58.8 MG of CSO and 458.6 MG of stormwater.

3.5.2 Characterization of Pollutant Concentrations, Baseline Condition

Pollutant concentrations associated with intermittent, wet weather-related discharges are highly variable. Some pollutants can exhibit first-flush behavior, with higher concentrations in the beginning of a storm and relatively constant concentrations later during the storm. Depending on the inter-event time between storms, certain pollutants exhibit different accumulation and wash-off rates. Many studies, including CSO control plan development in cities such as Washington, DC and the USEPA National Urban Runoff Program, have used the concept of event mean concentration (EMC) to characterize pollutant loads from CSO discharges (USEPA, 1983). Considering the variability in pollutant concentrations during rain events, the analyses documented in this report characterize discharged pollutants based on the relative portions of sanitary sewage and rainfall runoff in the discharged flows at any given point in time. Pollutant concentrations for sanitary sewage are attributed to the sanitary portion, and concentrations for stormwater are attributed to the rainfall runoff portion of the discharged flow volumes.

Tables 3-12 and 3-13 present the pollutant concentrations associated with the sanitary and stormwater components of discharges to Alley Creek and Little Neck Bay from Tallman Island and Nassau County, respectively. Sanitary concentrations were developed based on sampling of WPCP influent during dry-weather periods, as described elsewhere in more detail (HydroQual, 2005b). Stormwater concentrations were developed based on sampling conducted city-wide as part of the Inner Harbor Facility Planning Study (NYCDEP, 1994), and sampling conducted city-wide by NYCDEP for the USEPA Harbor Estuary Program (HydroQual, 2005a).

NYSDEC discharge monitoring reports (DMR) submitted by the Belgrave WPCP were reviewed to characterize the WPCP effluent for the Baseline Condition. The plant discharges an average 1.3 MGD. Average $CBOD_5$ and TSS concentrations are 10 mg/L. Total coliform, fecal coliform and enterococci are assumed to be negligible since the facility provides disinfection. Table 3-14 summarizes the Belgrave WPCP point source.

Table 3-12. Sanitary and Stormwater Discharge Concentrations, Tallman Island, Baseline Condition

Constituent	Sanitary Concentration	Stormwater Concentration
$CBOD_5$ (mg/L) [1]	140	15
TSS (mg/L) [1]	130	15
Total Coliform Bacteria (MPN/100mL) [2,3]	$25x10^6$	150,000
Fecal Coliform Bacteria (MPN/100mL) [2,3]	$4x10^6$	35,000
Enterococci (MPN/100mL) [2,3]	$1x10^6$	15,000

(1) HydroQual, 2005b.
(2) HQI Memo to NYCDEP, 2005a.
(3) Bacterial concentrations expressed as "most probable number" (MPN) of cells per 100 mL.

Table 3-13. Sanitary and Stormwater Discharge Concentrations, Nassau County, Baseline Condition

Constituent	Stormwater Concentration
$CBOD_5$ (mg/L) [1]	15
TSS (mg/L) [1]	15
Total Coliform Bacteria (MPN/100mL) [2,3]	50,000
Fecal Coliform Bacteria (MPN/100mL) [2,3]	25,000
Enterococci (MPN/100mL) [2,3]	15,000

(1) HydroQual, 2005b.
(2) HQI Memo to NYCDEP, 2005a.
(3) Bacterial concentrations expressed as "most probable number" (MPN) of cells per 100 mL.

Table 3-14. Belgrave WPCP (Nassau County) Discharge Baseline Condition[1]

Constituent	Concentration
$CBOD_5$ (mg/L)	10
TSS (mg/L)	10
Total Coliform Bacteria (MPN/100mL) [2]	<200
Fecal Coliform Bacteria (MPN/100mL) [2]	<200
Enterococci (MPN/100mL) [2]	<200

(1) NYSDEC, DMR data, 475 MG/yr.
(2) Disinfection practiced year-round.

3.5.3 Characterization of Pollutant Loads, Baseline Condition

Pollutant-mass loadings were calculated using the pollutant concentrations shown in Tables 3-12, 3-13 and 3-14 applied to the discharge volumes and sanitary/rainfall-runoff splits provided by the Tallman Island watershed model, as described above. Table 3-15 presents a summary of the annual discharges to Alley Creek and Little Neck Bay for the Baseline Condition from Tallman Island CSOs, Tallman Island stormwater discharged via CSO outfalls, Tallman

Island stormwater and direct runoff, Nassau County stormwater and direct runoff, and the Belgrave WPCP effluent discharge. The Baseline Condition CSO flow is approximately 17 percent of the total flow discharged to Alley Creek and Little Neck Bay. Approximately, 16 percent of the Baseline Condition volume discharged is from the Belgrave WPCP. Most of the flow (~70 percent) is stormwater discharge and direct runoff. The Belgrave source is constant, as contrasted to the CSO and stormwater sources that are wet weather discharges. The Belgrave WPCP represents 11 percent of the Baseline $CBOD_5$ and TSS discharged to the Alley Creek and Little Neck Bay. Tallman Island CSO and stormwater sources are 39 percent of the $CBOD_5$ and TSS loads. Nassau County stormwater is approximately 31 percent. In contrast, the Belgrave WPCP contributes negligible total coliform, fecal coliform and enterococcus. Tallman Island discharges represent 90 percent, 80 percent and 70 percent of the total loads of total coli, fecal coli and enterococcus. The remainder of the total is from Nassau stormwater. It should be noted that of the total loads of total coliform, fecal coliform and enterococcus, to the Alley Creek and Little Neck Bay waters, 46 percent, 37 percent and 29 percent, respectively, are discharged from TI-008. Figure 3-8 graphically presents the information in Table 3-15 as relative contributions of each source category to the total discharged to Alley Creek and Little Neck Bay.

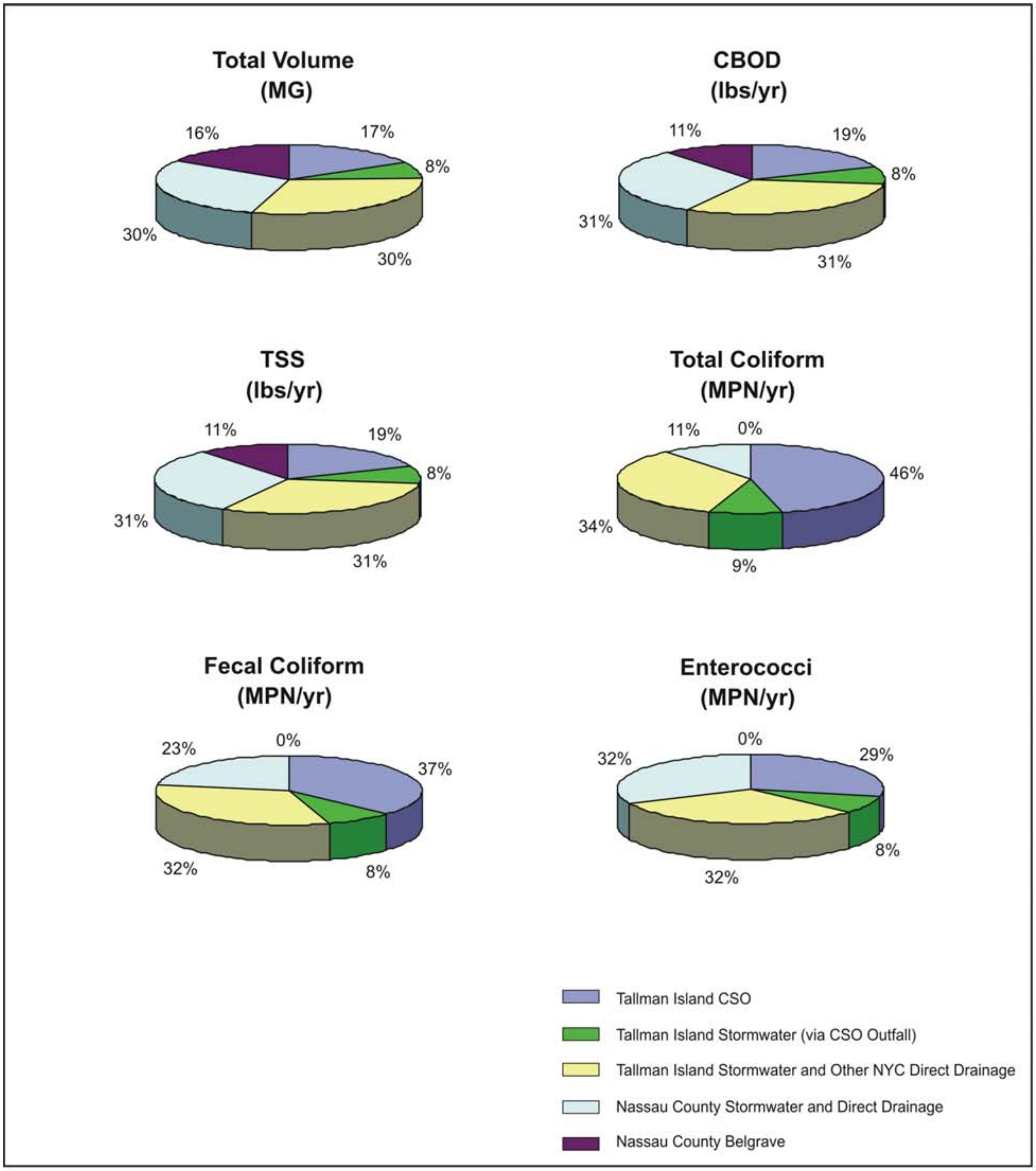
The Baseline Condition case did not include any localized sources of pathogens in the Douglaston Manor peninsula area that are known to impact Douglas Manor Association (DMA) Beach water quality and limit its use. The purpose of the Baseline is to evaluate the water quality improvement associated with CSO control alternatives. For long-term LTCP planning time horizons, the localized sources were assumed to have been eliminated.

The information summarized in Table 3-15 and Figure 3-8 was examined on the basis of loads entering Alley Creek and loads entering Little Neck Bay. Table 3-16 summarizes the sources to Alley Creek: CSO Loading, Stormwater Discharged via CSO Outfalls and Stormwater and Direct Runoff. All of the Alley Creek sources are from the Tallman Island WPCP area. Similarly, the Tallman Island (NYC) sources and Nassau County sources are presented for Little Neck Bay loads. There are no CSO loads to Little Neck Bay. Table 3-16 shows that the Alley Creek CSO from TI-008 is a significant portion of the loads to Alley Creek.

Table 3-15. CSO, Stormwater and Point Source Discharge Loadings - Baseline Condition

Constituent	Nassau County(1)			Tallman Island(1,2)		
	Belgrave WPCP	CSO Loading	Stormwater and Direct Runoff	CSO Loading(4)	Stormwater Discharge via CSO Outfall	Stormwater and Direct Runoff(3)
Volume (MG)	475	0	893	517	229	898
$CBOD_5$ (1000 lbs/yr)	40	0	112	69	29	112
TSS (1,000 lbs/yr)	40	0	112	69	29	112
Total Coliform Bacteria (org/yr)	<.004 x 10^{15}	0	1.7 x 10^{15}	7.1 x 10^{15}	1.3 x 10^{15}	5.1 x 10^{15}
Fecal Coliform Bacteria (org/yr)	<.004 x 10^{15}	0	0.8 x 10^{15}	1.3 x 10^{15}	0.3 x 10^{15}	1.2 x 10^{15}
Enterococci (org/yr)	<.004 x 10^{14}	0	5.1 x 10^{14}	4.6 x 10^{14}	1.3 x 10^{14}	5.1 x 10^{14}

(1) Loadings represent annual total during Baseline simulation.
(2) Tallman Island Operating Capacity 122 MGD.
(3) Does not include stormwater discharged via CSO Outfalls.
(4) Only TI-008 discharges CSO; 58.8 MG CSO and 458.6 MG stormwater (see Table 3-10).



New York City
Department of Environmental Protection

Alley Creek and Little Neck Bay
Baseline Loading Sources

Alley Creek and Little Neck Bay Waterbody/Watershed Facility Plan

FIGURE 3-8

Table 3-16. CSO, Stormwater and Point Source Discharge Loadings to Alley Creek and Little Neck Bay - Baseline Condition

Constituent	Alley Creek			Little Neck Bay				
	Tallman Island[1,2]			Tallman Island[1,2]			Nassau County[1]	
	CSO Loading[4]	Stormwater Discharged via CSO Outfalls	Stormwater & Direct Runoff[3]	CSO Loading[5]	Stormwater Discharged via CSO Outfalls	Stormwater and Direct Runoff[3]	Belgrave WPCP	Stormwater & Direct Runoff
Volume (MG)	517	120	321	0	109	577	475	893
$CBOD_5$ (1,000 lbs/yr)	69	15	40	0	14	72	139	112
TSS (1000 lbs/yr)	69	15	40	0	14	72	139	112
Total Coliform Bacteria [6]	7.1×10^{15}	0.7×10^{15}	1.7×10^{15}	0	0.6×10^{15}	3.2×10^{15}	$<.004 \times 10^{15}$	1.7×10^{15}
Fecal Coliform Bacteria[6]	1.3×10^{15}	0.2×10^{15}	0.4×10^{15}	0	0.1×10^{15}	0.8×10^{15}	$<.004 \times 10^{15}$	0.8×10^{15}
Enterococci[6]	4.6×10^{14}	0.7×10^{14}	1.8×10^{14}	0	0.6×10^{14}	3.3×10^{14}	$<.004 \times 10^{14}$	5.1×10^{14}

(1)Loadings represent annual total during Baseline simulation.
(2)Tallman Island Operating Capacity 122 MGD.
(3)Does not include stormwater discharged via CSO Outfalls.
(4)Only TI-008 discharges CSO; 58.77 MG CSO and 458.6 MG stormwater.
(5)TI-006 (discharges only stormwater).
(6)Bacterial loadings expressed as most probable number (MPN).

Considering all of the 517 MG of flow from TI-008 as CSO, for the design year 1988 rainfall, Baseline CSO represents 54 percent of flow, 56 percent of the $CBOD_5$ and TSS load, 75 percent of total coliform load, 68 percent of fecal coliform load, and 65 percent of enterococcus load to Alley Creek.

3.5.4 Effects of Urbanization on Discharge

The urbanization of the Alley Creek and Little Neck Bay drainage area from a pastoral watershed to a developed urban/suburban sewershed is described in Section 2. The pastoral condition featured undeveloped uplands that provided infiltration of incident rainfall and contributed continuous freshwater inputs. Urbanization brought increased population, increased pollutants from sewage and industry, construction of sewer systems, and physical changes affecting the surface topography and imperviousness of the watershed. Increased surface imperviousness generates more runoff that is less attenuated by infiltration processes, and the sewer systems replaced natural overland runoff pathways with a conveyance system that routes the runoff directly to the waterbody without the attenuation formerly provided by surrounding wetlands. As a result, more runoff is generated, and it is conveyed more quickly and directly to the waterbody. These changes also affect how pollutants are transferred along with the runoff on its way to the waterbody. Furthermore, the urbanized condition also features additional sources of pollution from CSOs and industrial/commercial activities.

Urbanization of the watershed has altered its runoff yield tributary to Alley Creek and Little Neck Bay by increasing its imperviousness. Imperviousness is a characteristic of the ground surface that reflects the percentage of incident rainfall that runs off the surface rather than being absorbed into the ground. While natural areas typically exhibit imperviousness of 10 to 15 percent, imperviousness in urban areas can be significantly higher (60 to 90 percent).

In a pastoral condition, runoff from a watershed reaches the receiving waters through a combination of overland surface flow and subsurface transport, typically with ponding and other opportunities for retention and infiltration. The extensive tidal wetland areas previously surrounding Alley Creek and Little Neck Bay would have further attenuated wet-weather runoff and pollutant effects. However, the urbanization of Alley Creek and Little Neck Bay watershed reduced infiltration and natural subsurface transport and eliminated natural streams previously tributary to Alley Creek and Little Neck Bay. Runoff is transported via roof leaders, street gutters and catch basins into the combined and separate sewer system, which then discharges directly to Alley Creek and Little Neck Bay since the wetlands have been eliminated. Urbanization has thus simultaneously decreased retention and absorption of runoff during transport and decreased the travel time for runoff to reach the waterbody. When combined with the increased runoff due to increased imperviousness of the watershed, the end result is increased peak discharge rates and higher total discharge volumes to the waterbody during wet weather and lower freshwater flow volumes (groundwater) during dry weather periods resulting from reduced infiltration.

Urbanization has also altered the pollutant characteristics of wet-weather discharges from the watershed. The original rural landscape of forests, fields and wetlands represents pristine conditions with pollutant loadings resulting from natural processes (USEPA, 1997). These natural loadings, while having an impact on water quality in the receiving water, are subjected to natural attenuation process. For example, depending on the holding time, the volume of water in the wetland may go through nutrient attenuation or bacterial decay before discharging into the Alley Creek and Little Neck Bay. On the other hand, wet-weather discharges from urbanized areas have significantly higher pollutant concentrations than natural runoff. These pollutants include coliform bacteria, oxygen-demanding materials, suspended and settleable solids, floatables, oil and grease, and other materials.

A summary of the hydrologic changes caused by urbanization in the New York City portion of the Alley Creek and Little Neck Bay watershed is presented in Table 3-17. The pre-urbanized condition is assumed circa 1900. The runoff volume has increased. Runoff yield for an average precipitation year as calculated by the landside model has increased from approximately 500 MG of natural runoff to approximately 3,000 MG (see Table 3-11) discharged by combined and separate sewer systems to Alley Creek and Little Neck Bay, an increase of 600 percent. Significantly larger discharges are now made directly to the Alley Creek and Little Neck Bay at higher rates since they are no longer attenuated, filtered, and mitigated by "natural" overland mechanisms.

Table 3-17. Effects of Urbanization on Watershed Loading

Category	Pre-Urbanization[1]	Urbanized[2]	Change (%)
Runoff Volume (MG)	500	3000	+600%
Total Suspended Solids (TSS) Load [lbs/yr]	63,000	322,000	+500%
Biochemical Oxygen Demand (BOD) Load [lbs/yr]	63,000	322,000	+500%

(1) Circa 1900, using stormwater concentrations
(2) For an average precipitation year (JFK, 1988)

A pollutant loading comparison is summarized in Table 3-17 using typical pollutant concentrations from literature sources. The table compares pre-urbanized pollutant loadings of total suspended solids and biochemical oxygen demand to the existing urbanized condition. The annual volumes used for this table are taken from those in Table 3-15 assuming an average precipitation year. Typical stormwater concentrations are used for the pre-urbanized condition. The urbanized condition accounts for existing CSO and stormwater discharges. The table demonstrates that urbanization of the watershed has increased pollutant loadings to the Alley Creek and Little Neck Bay waters by a factor of approximately five.

3.5.5 Toxics Discharge Potential

Early efforts to reduce the amount of toxic contaminants being discharged to the New York City open and tributary waters focused on industrial sources and metals. For industrial source control of separate and combined sewer systems, the USEPA requires approximately 1,500 municipalities nationwide to implement Industrial Pretreatment Programs (IPPs). The intent of the IPP is to control toxic discharges to public sewers that are tributary to sewage treatment plants by regulating Significant Industrial Users (SIU). If a proposed IPP is deemed acceptable, USEPA will decree the local municipality a "control authority." NYCDEP has been a control authority since January 1987, and enforces the IPP through Chapter 19 of Title 15 of the Rules of the City of New York (Use of the Public Sewers), which specifies excluded and conditionally accepted toxic substances along with required BMPs for several common discharges such as photographic processing waste, grease from restaurants and other nonresidential users, and perchloroethylene (PERC) from dry cleaning. The NYCDEP has been submitting annual reports on its activities since 1996. The 310 SIUs that were active citywide at the end of 2004 discharged an estimated average total mass of 38.2 pounds per day (lbs/day) of the following metals of concern: arsenic, cadmium, copper, chromium, lead, mercury, nickel, silver and zinc.

As part of the IPP, NYCDEP analyzed the toxic metals contribution of sanitary flow to CSOs by measuring toxic metals concentrations in WPCP influent during dry weather in 1993. This program determined that of the 177 lbs/day of regulated metals being discharged by regulated industrial users only 2.6 lbs/day (1.5 percent) were bypassed to CSOs. Of the remaining 174.4 lbs, approximately 100 lbs ended up in biosolids, and the remainder was discharged through the main WPCP outfalls. Recent data suggest even lower discharges. In 2003, the average mass of total metals discharged by all regulated industries to the New York City WPCPs was less than 39.1 lbs/day, which would translate into less than 1 lb/day bypassed to CSOs from year 2003 regulated industries if the mass balance calculated in 1993 is assumed to be maintained. A similarly developed projection was cited by the 1997 NYCDEP report on meeting the nine minimum CSO control standards required by federal CSO policy, in which NYCDEP considered the impacts of discharges of toxic pollutants from SIUs tributary to CSOs (NYCDEP, 1997a). The report, audited and accepted by USEPA, includes evaluations of sewer system requirements and industrial user practices to minimize toxic discharges through CSOs. It was determined that most regulated industrial users (of which SIUs are a subset) were discharging relatively small quantities of toxic metals to the NYC sewer system. There are no SIUs located in the Alley Creek and Little Neck Bay drainage area. In addition, NYSDEC has not listed Alley Creek and Little Neck Bay as being impaired by toxic pollutants. As such, metals and toxic pollutants are not considered to be pollutants of concern for the development of this Waterbody/Watershed Facility Plan.